Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

EB-134E BALLOON, LEAFLET NEOPRENE STUDY

4

INVESTIGATION INTO THE GROUND AND FLIGHT CHARACTERISTICS OF J-100 AND J9-10-300 NEOPRENE BALLOONS

FINAL REPORT

COVERING PERIOD OF JUNE 1, 1957 - JANUARY 1, 1958

RLP#

DEWEY AND ALMY CHEMICAL COMPANY
Division of W. R. Grace & Co.
CAMBRIDGE, MASSACHUSETTS

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

DEWEY AND ALMY CHEMICAL COMPANY RESEARCH LABORATORY

PROBLEM #

INVESTIGATION INTO THE GROUND AND FLIGHT CHARACTERISTICS OF J-100 AND J9-10-300 NEOPRENE BALLOONS

FINAL REPORT

COVERING PERIOD OF JUNE 1, 1957 - JANUARY 1, 1958

OBJECT OF RESEARCH

STUDY THE GROUND AND FLIGHT CHARACTERISTICS OF THE DAREX J-100 AND J9-10-300 BALLOONS CARRYING CERTAIN SPECIFIED PAYLOADS AND FREE LIFTS.

25X1

RLP#

25X1

REPORTED BY:

Francis T. Mansur
Project Engineer

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

TABLE OF CONTENTS

I ABSTRACT

II INTRODUCTION

III GENERAL DISCUSSION

A. Manufacture

B. Theoretical Consideration

IV TEST DATA AND ANALYSIS

A. Test Program

B. Ground Burst Diameter vs Flight Test Burst Diameter

1.) Time and Temperature Effect

2.) Effect of Payload

3.) Effect of Ozone

4.) Effect of Solar Radiation

5.) Effect of Atmospheric Turbulence

C. Performance of Aged Balloons

D. Adverse Weather Flights

E. Ascensional Rate

F. Room Temperature Diffusion Rate of J-100 Balloons

G. Adiabatic Cooling of Inflation Gas

H. Summary of Data Analysis: Conclusions

VII REFERENCES

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

TABLES:

1.) Ground-Burst Test Data

2.) Expected Versus Observed Burst Altitude

3.) Cold Cabinet Tests - Prototype Neoprene Balloons

4.) Payload Versus Temperature at Burst

5.) Flight Tests with No Load Attached

6.) Ground Burst Tests With Load Attached

7.) Burst Diameters: Night Flights Versus Day Flights

8.) Aged Balloon Flights J-100 White Balloons

9.) Adverse Weather Versus Clear Weather Flights

10.) Factors for Use in Deriving Ascensional Rate

11.) Theoretical Versus Observed Ascensional Rate

12.) Loss of Free Lift Due to Permeability

FIGURES:

1.) Distance Control by Payload and Free Lift Variations

2A) - 2B) - 2C) Light-Weight Modified Radiosonde

3.) Burst Diam./Ground Diam. Versus Altitude

4.) Time-Altitude-Temperature Curve

5.) Friction Coeficient Versus Reynold's Number

6.) Relation Between Gross Lift and Loss of Free Lift Due to Diffusion

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

I. ABSTRACT

An account is given of a series of ground and flight tests designed to impart information regarding the performance characteristics of the J-100 and J9-10-300 DAREX neoprene ballons.

The following parameters were considered:

1.) Burst diameter
2.) Altitude
3.) Rate of rise
4.) Permeability to hydrogen at sea level
5.) Uniformity of performance
6.) Adverse weather flight characteristics
7.) Aging characteristics

The capabilities of the J-100 ballon in particular have been extensively examined and, wherever possible, explanations have been given for the phenomena encountered during the test program.

It was found that:

1.) Because of the influence of flight time and temperature on the elongation capabilities of the ballons, those balloons having a low ascensional rate did not achieve as large a burst volume as those having a high ascensional rate. Consequently, the bursting altitude for a given payload was independent of the free lift in the range considered.

2.) Because of the inverse relationship between ground volume and burst altitude, the altitude decreased progressively with each increase in payload.

3.) The ascent rate for J-100 balloons in the range considered ranges from 250 feet per minute with 50 grams of free lift to 660 feet per minute with 500 grams of free lift. For the J-9-10-300 balloons the ascent rate ranged from 500 feet per minute with 300 grams of free lift to

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

850 feet per minute with 1000 grams of free lift.

4.) The permeability to hydrogen at sea level was found to increase in direct proportion to the gross lift. The rate of loss of lift was found to be 11.4 grams/hr. for a 1 lb. load and increased progressively to 48.4 grams/hr. for a 6 lb. load.

5.) The uniformity of performance of the J-100 balloons was found to be such that the average standard deviation for a group of balloons having the same payload and free lift is ± 2,600 feet. The ascensional rates within a group having the same payload and free lift were generally within ± 10% of the average.

6.) It was observed that overcast skies did not appreciably affect the bursting altitude of the J-100 balloons.

7.) Aged balloons performed well up to a period of 1 year of shelf-storage.

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

II. INTRODUCTION

This report covers a series of tests designed to impart more precise technical and operational information on Darex J-100 and J9-10-300 balloons than is currently available. More specifically, it is a study of the ground and flight characteristics of these balloons for their application to carrying unusual and varied payload and free-lift combinations. As the science of meteorology advances, it becomes desirable to have a greater control and better understanding of the instrument-carrying balloons used either in studying the atmosphere or in other wind-dependent operations. The J-100 balloon heretofore has been used primarily as a pilot balloon to determine wind direction and velocity at various altitudes; also the height, direction and velocity of clouds whenever the balloons enter their bases. Little is known concerning the ability of these small balloons to carry unusual payloads or of their ascensional rates with low free lifts. This study is aimed at clearing up some of the questions involved in this respect, in order to enable the accurate projection of a predetermined payload to a predetermined point in space at a known rate of ascent.

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

III GENERAL DISCUSSION

A. Manufacture

B. Theoretical Considerations

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

III. GENERAL DISCUSSION

A. Manufacture

Darex meteorological balloons are manufactured from a specially prepared duPont neoprene latex, compounded by the Dewey and Almy Chemical Company to impart a high degree of stretch, cold resistance, gas impermeability, and resistance to deterioration due to aging and exposure. The process used in manufacture is the single-compound-dip, gel-expansion method, wherein an impervious mold is coated with coagulant and dipped into the latex compound causing a thin gel to form on the mold. Progressive diffusion of the coagulant salt through this thin layer coagulates to form a thicker, finely knit gel. The thickness of the gel is determined by the length of time the mold is allowed to dwell in the compound. Once the desired thickness is obtained, the mold is removed from the compound and allowed to air set for a short time until the process of spontaneous exudation of serum, known as synaeresis, commences. The gel is then immersed in water which causes an osmotic flow of the serum to take place with a consequent increase in total solids. The gel, after toughening, is stripped from the mold, washed, and inflated to 4.75 times its original diameter and dried to permanently increase its size. The mechanism by which it is believed this permanent increase in size takes place, is that during the expansion of the gel the polymer micelles move on their water matrices until such time as when the area has become so large that the now thinly dispersed water no longer affords lubrication and the micelles come in contact with each other resulting in adhesion and loss of further plastic movement. Inflation beyond this point becomes elastic and reversible. Once the balloon is dried it is vulcanized in a hot air oven for six hours at 230° F. then inspected and packed in cartons to be opened again only when ready for use.

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

The factory specifications for the balloons studied in this project are the following:

Type	Weight	Diameter	Sea-Level Burst Diameter	Sea-Level Burst Volume	Thickness At Flaccid	Thickness At Burst
J-100	100 gms.	16 inches	90( ) inches	216 cu. ft.( )	.004 inch	.0001 inch
J9-10-300	300 gms.	29 inches	12.5 ( ) feet	1,023 cu. ft.( )	.004 inch	.0001 inch

B. Theoretical Considerations

Archimedes law states that the buoyant or upward force exerted on a body immersed in a fluid is equal to the weight of the fluid displaced. A body immersed in fluid displaces its own volume of fluid. If the weight of the fluid displaced equals the weight of the body, the body is in equilibrium. If the weight of the fluid displaced is greater than the weight of the body, the body rises, and if the weight of the fluid displaced is less than the weight of the body the body falls. Thus if a balloon is filled with a gas having a density less than that of air, the balloon will possess a buoyancy or gross lift as expressed by the following equation:

$L = V(d_a - d_g)$ where: $L =$ gross lift or buoyancy, $=$ free lift $+$ payload $+$ weight of balloon

$V =$ Volume of gas.

$d_a =$ Density of air.

$d_g =$ Density of gas.

In the case of an extensible balloon, if the gross lift is greater than the weight of the balloon and its payload, (i.e. if the balloon possesses a "free-lift"), and if the balloon is tied off so that no gas can escape, it will rise. As it gains altitude the atmospheric pressure decreases because of a decrease in air density. This decrease in air pressure allows the volume of the gas inside the balloon to increase and thus expand the balloon. The balloon continues to rise

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

and expand in this manner until it reaches a point where the film becomes so thin that further expansion is no longer possible and rupture occurs, thus terminating the flight. The relationship between gross lift and altitude can easily be seen if we can assume a most probable bursting volume. If a balloon starts its ascension with a large ground volume it will require a certain decrease in atmospheric pressure to expand to its bursting volume. A similar balloon starting off with a smaller volume will require a greater decrease in pressure and thus a higher altitude, to arrive at its bursting volume. Since the ground volume depends on gross lift it is evident that altitude is also dependent on gross lift.

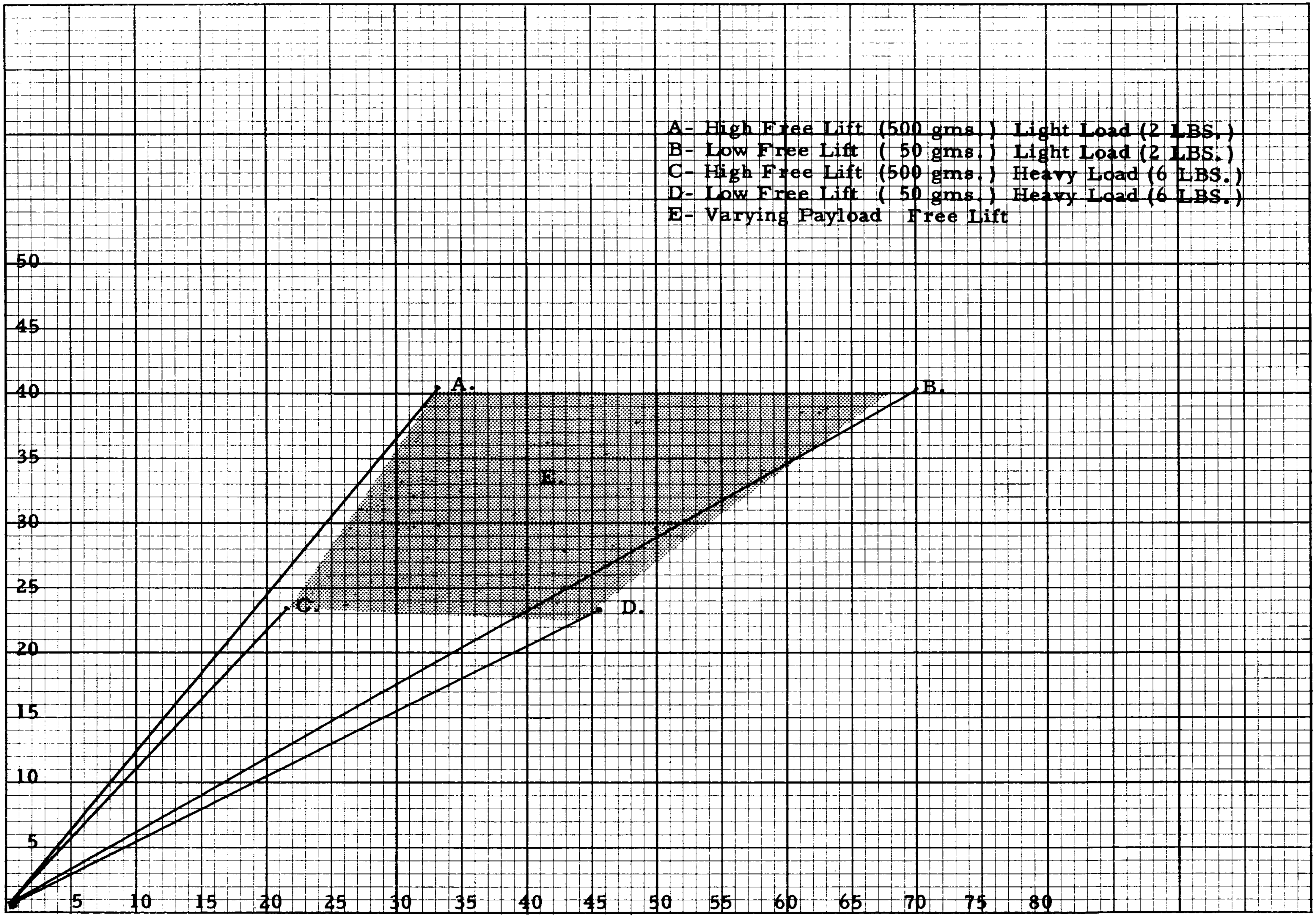
Thus it is possible to control the altitude at which a neoprene balloon will burst by choosing the proper payload and free lift. Since the free lift also determines the ascensional rate the time spent in flight can also be controlled. This relationship is represented graphically in figure 1.

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

NO. 325. 10 DIVISIONS PER INCH BOTH WAYS. 70 BY 100 DIVISIONS. CODEX BOOK COMPANY, INC. NORWOOD, MASSACHUSETTS

Fig. 1. Distance Control By Load and Free Lift Variations.



Ground Distance (Miles) Assuming A Mean Wind Speed of 30 M.P.H.

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

IV. GROUND AND FLIGHT TEST DATA AND ANALYSIS

A. Test Program

B. Theoretical Relationship Between Ground Diameter, Burst Diameter and Altitude.

C. Ground Burst Diameters versus Flight-Test Burst Diameters.

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

A. TEST PROGRAM

In order to obtain a more accurate knowledge of the capabilities of the J-100 and J9-10-300 Darex neoprene balloons the following test program was carried out during this project.

TASK I. Existing Data and Ground Tests

Phase (a) Study the existing data on J-100 balloons as compiled by the U. S. Weather Bureau. The balloons tested by the Weather Bureau carry no payload, bursting elevation being determined via theodolite tracking technique, and are valuable in determining the maximum altitude which can be obtained by the J-100 balloon.

Phase (b) Conduct a series of ground burst tests of the J-100 and J9-10-300 balloons, using existing laboratory facilities, to determine what bursting dimensions can be normally expected at sea level. These results are to be compared with a series of flight tests in order to ascertain whether or not the balloons are reaching their maximum burst diameters during flight.

Phase (c) Investigate variations in free lift (and consequently gross lift), caused by adiabatic cooling of inflation gas at various rates of flow. Since the volume of a gas varies directly with the temperature of the gas (at constant pressure), more gas than is necessary may be put into the balloon to achieve a given free lift. As the gas becomes warmer it may turn out that the balloon has more lift than is intended.

Phase (d) Plot the room temperature diffusion rate of the J-100 balloon inflated to flight dimensions. Sometimes it becomes desirable or even necessary to hold an inflated balloon for a period of time before launching. In these cases a knowledge of the amount of diffusion, and consequently lifting force lost, becomes valuable.

TASK II. Study the performance of the J-100 and J9-10-300 by Field Testing.

A series of flight tests were carried out under varying weather conditions

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

and varying payload-free lift combinations. Altitudes and ascensional rates of the balloons were determined to a high degree of accuracy by use of radiosonde tracking technique. Since the standard radiosonde weighs in excess of two pounds, a problem was encountered in those flights which required a payload of exactly two pounds. This problem was overcome by removing the radiosonde sensor mechanism from its regular plastic housing and re-installing it in a hand-made housing of lightweight rigid styro-foam. (For details of procedure see Figures 2A, 2B.) The flight test program was broken down into the following phases:

Phase 1.

J-100 clear weather daytime flights. External loads of 2, 3, 4, and 6 lbs. Free lifts of 50, 100, 200, 350, and 500 grams for 2 3 lb. payload, 200 500 grams free lift for 4 6 lb. payload. Five flights for each payload-free lift combination making a total of 70 flights in this phase.

Phase 2.

J-100 adverse weather daytime flights. External load of 3 lbs. Free lift of 200 grams.

Weather Conditions:

Light cloud cover - 5 flights

Heavy cloud cover - 5 flights

Rain - 5 flights

Total of 15 flights in phase 2.

Phase 3.

J-100 aged balloons, clear weather, daytime flights. External load of 3 lbs. Free lift of 200 grams. Total 5 - 20 flights. Enough flights were flown on aged balloons to determine at what point during shelf-storage their extensibilities become impaired.

Phase 4.

J-100 nighttime flights. External load of 3 lbs. Free lift of 200 grams.

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Weather Conditions:

Clear - 10 flights

Light cloud cover -)
- 5 flights
Heavy cloud cover-)

Phase 5.

J9-10-300 clear weather daytime flights. External loads of 5 and 10 lbs. Free lift 300, 700, and 1000 grams for 10 lb. load. Free lift of 300 and 700 grams for 5 lb. load, 4 flights for each payload free lift combination.

Phase 6.

J-100 clear weather daytime flights. Balloons preheated by a treatment of five minutes in water at a temperature of 180°F. minimum. External load of 3 lbs. Free lift of 200 grams. Fresh balloons, (no more than 3 months old,) are used in this phase to determine whether any crystallization has taken place between time of manufacture and time of use.

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

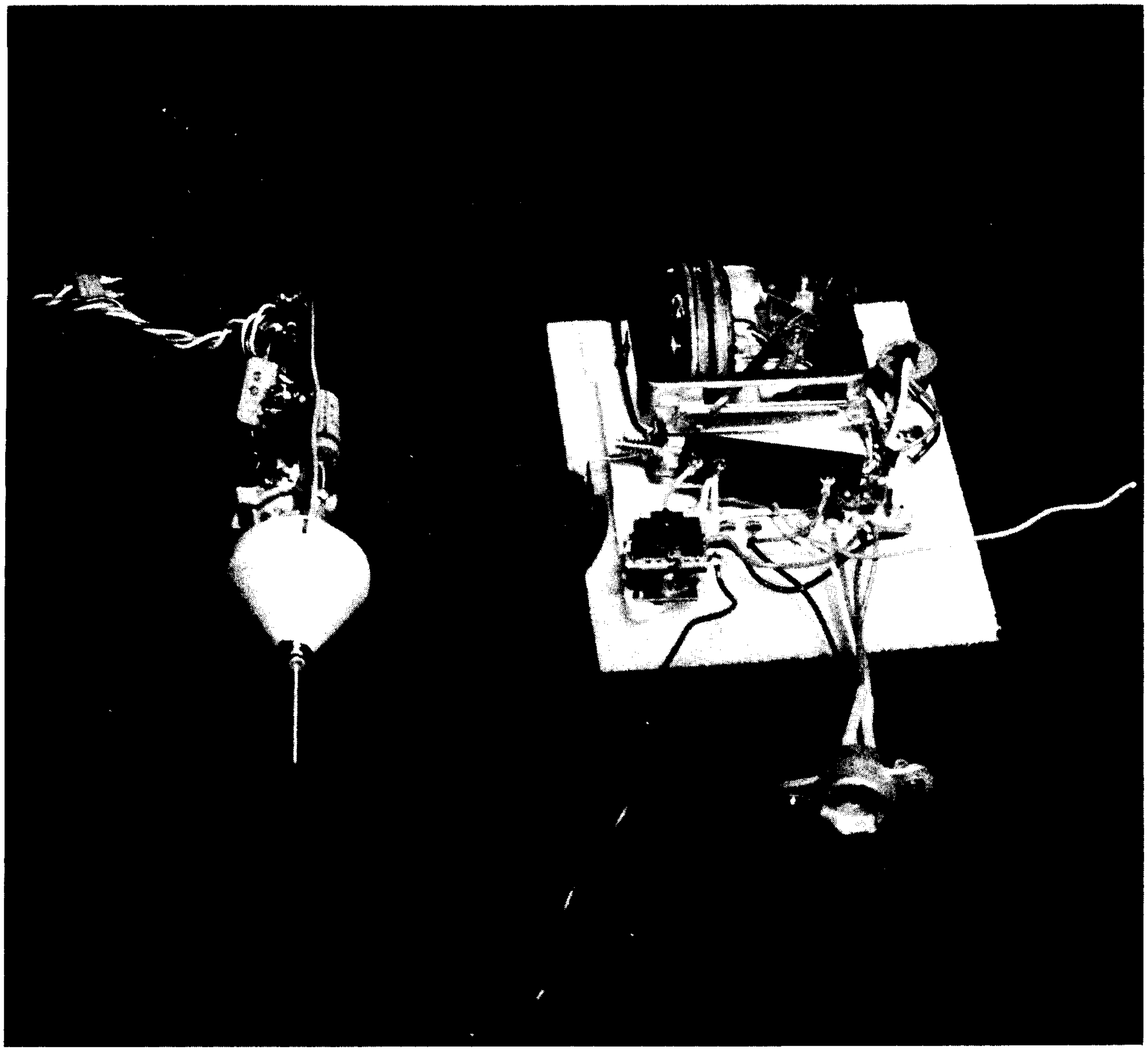


Fig. 2A.

Sensor mechanism is stripped of its plastic housing.
Transmitter is removed from its casing.

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

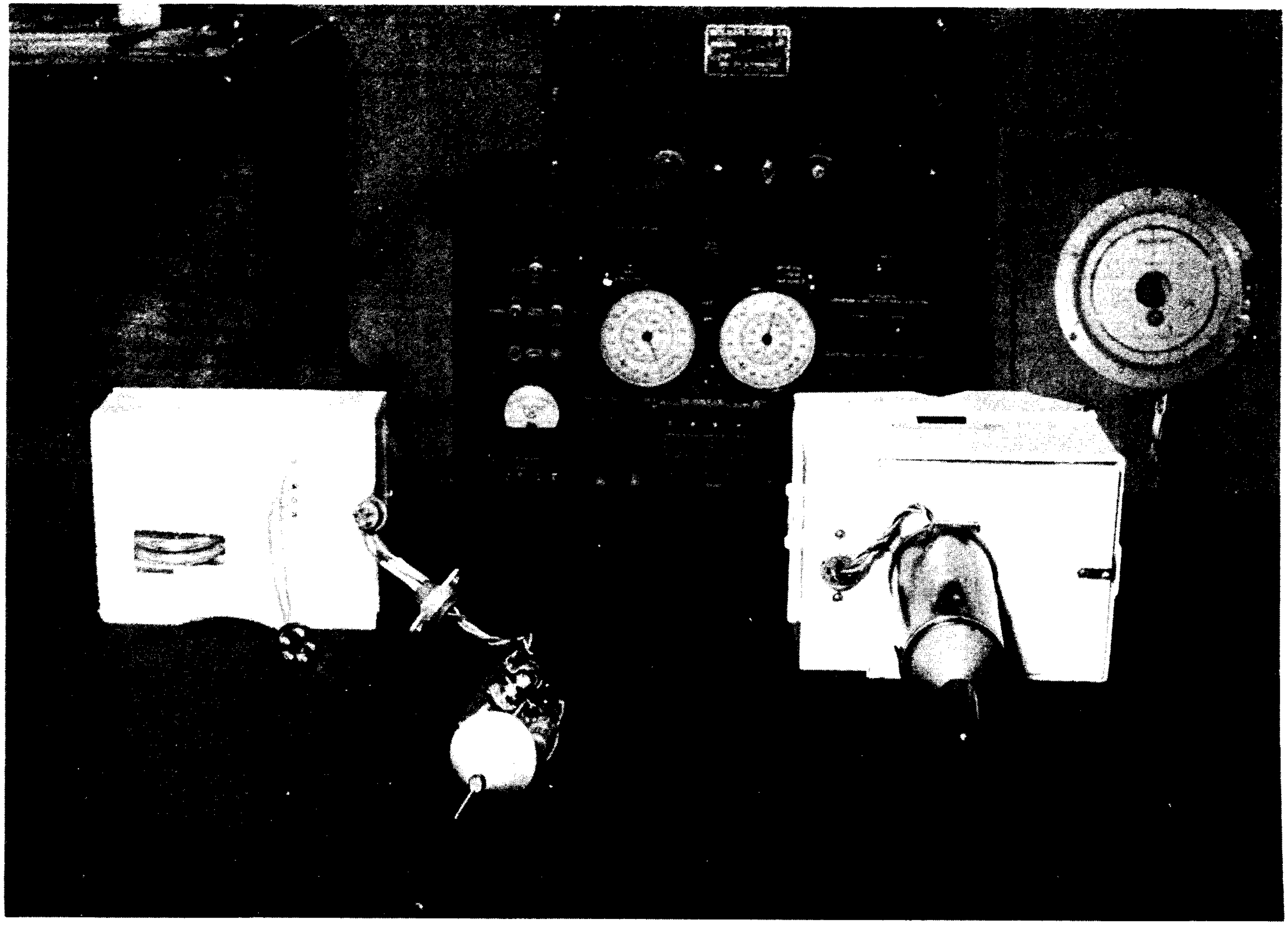


Fig. 2B.

Sensor mechanism is installed in light-weight styro-foam housing (right).
Original size of standard radiosonde is shown at left.

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

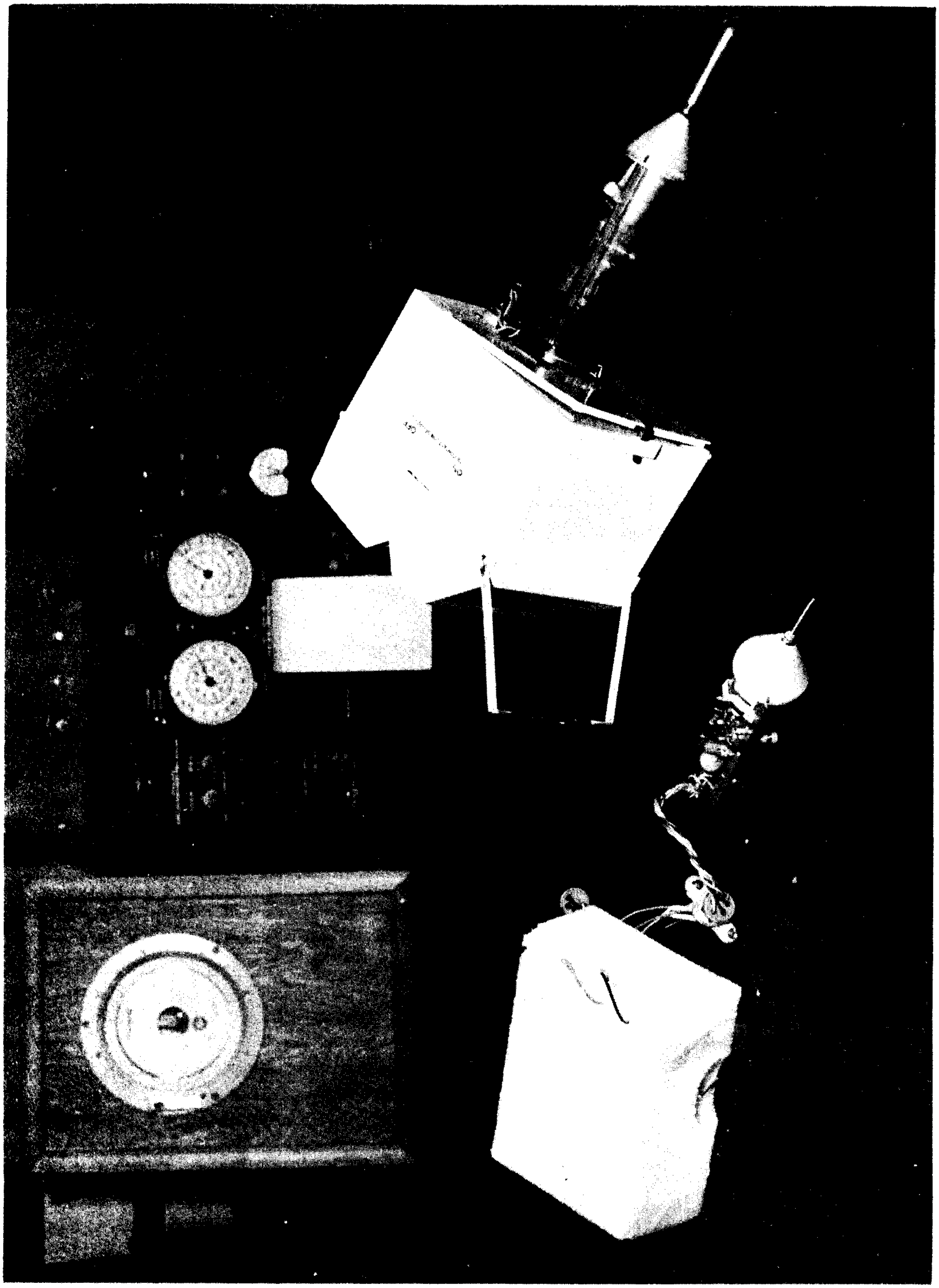


Fig. 2C.

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Procedure for modifying radiosonde:

A standard AN/AMT-4A radiosonde is stripped of its white plastic housing as follows:

1.) Remove the studs which anchor the sensor mechanism platform to the housing.

2.) Cut the wire leading to the humidity element.

3.) Cut the wires leading to the metal thermistor clamps.

4.) Remove the sensor mechanism from the housing.

5.) Prepare light-weight styrofoam housing by cutting a total of 6 sections to the following dimensions; 2 sections 6.25x4.75 inches (these will be the top and bottom of the new housing); 2 sections 6.25x2.25 inches (these will be the sides); 2 sections 4.5x2.25 inches (these will be the front and back).

6.) Anchor the sensor mechanism to the bottom of the new housing via the battery wire connections. (fig. 2B)

7.) Cut away part of the bottom to prevent housing from touching aneroid BELLOWS ~~balloons~~. (fig. 2B)

8.) Make sure transmitter cable and ground-check plug are outside of housing. (fig. 2B)

9.) Build up sides and top of housing with the aid of scotch tape.

10.) Cut two small holes in top of housing and expose temperature circuit wires. (fig. 2C)

11.) Attach thermistor to temperature leads. Plug in transmitter.

12.) Plug in battery and tape battery to the housing.

13.) Cut away part of side to expose on-off switch. (fig. 2C)

14.) Radiosonde is now ready for use. No humidity element is used.

15.) Remove transmitter housing and cover transmitter with transparent polyethylene bag if further weight reduction is desired.

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

B. Theoretical Relationship Between Burst Volume and Altitude

The volume of a balloon at burst is calculated from the relationship:

$$V_2 = NR \frac{T_2}{P_2}$$

where: V_2 = volume at burst (cubic feet)

N = gross lift (lbs.) ÷ (molecular wt. of air - molecular wt. of H_2)

$R = 1.33 \times 10^3$

T_2 = temperature at burst (°K)

P_2 = pressure at burst (millibars)

Thus, if a most probable burst volume is assumed from a series of ground burst tests, the theoretical bursting altitude can be predicted from the relationship:

$$\frac{T_2}{P_2} = \frac{V_2}{NR}$$

For the sake of convenience in predicting bursting altitude when the most probable burst volume is known, a graph (fig.3) has been prepared wherein altitude is plotted as a function of $\frac{T}{P}$. The atmospheric conditions on which the graph is based have been derived from soundings taken at Vernalis, California, the site where the flight tests in Task II were carried out.

Example: Ground burst tests indicate that J-100 balloons will burst at an average volume of 268 cubic feet. Thus for a ballon carrying a 3 lb. load with 200 grams of free lift:

$$N = 3.67 \text{ lbs.}/26.9 = .136 \text{ \# moles}$$

$$\frac{268}{(.136)(1.33 \times 10^3)} = 1.47 = \frac{T_2}{P_2}$$

Referring to the graph in fig. 3 we find the altitude to be 46,500 feet.

Using the data from the ground burst tests and referring to fig. 3,

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

the expected performances of the J-100 and J9-10-300 balloons were calculated and compared to actual flight tests in table 2.

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

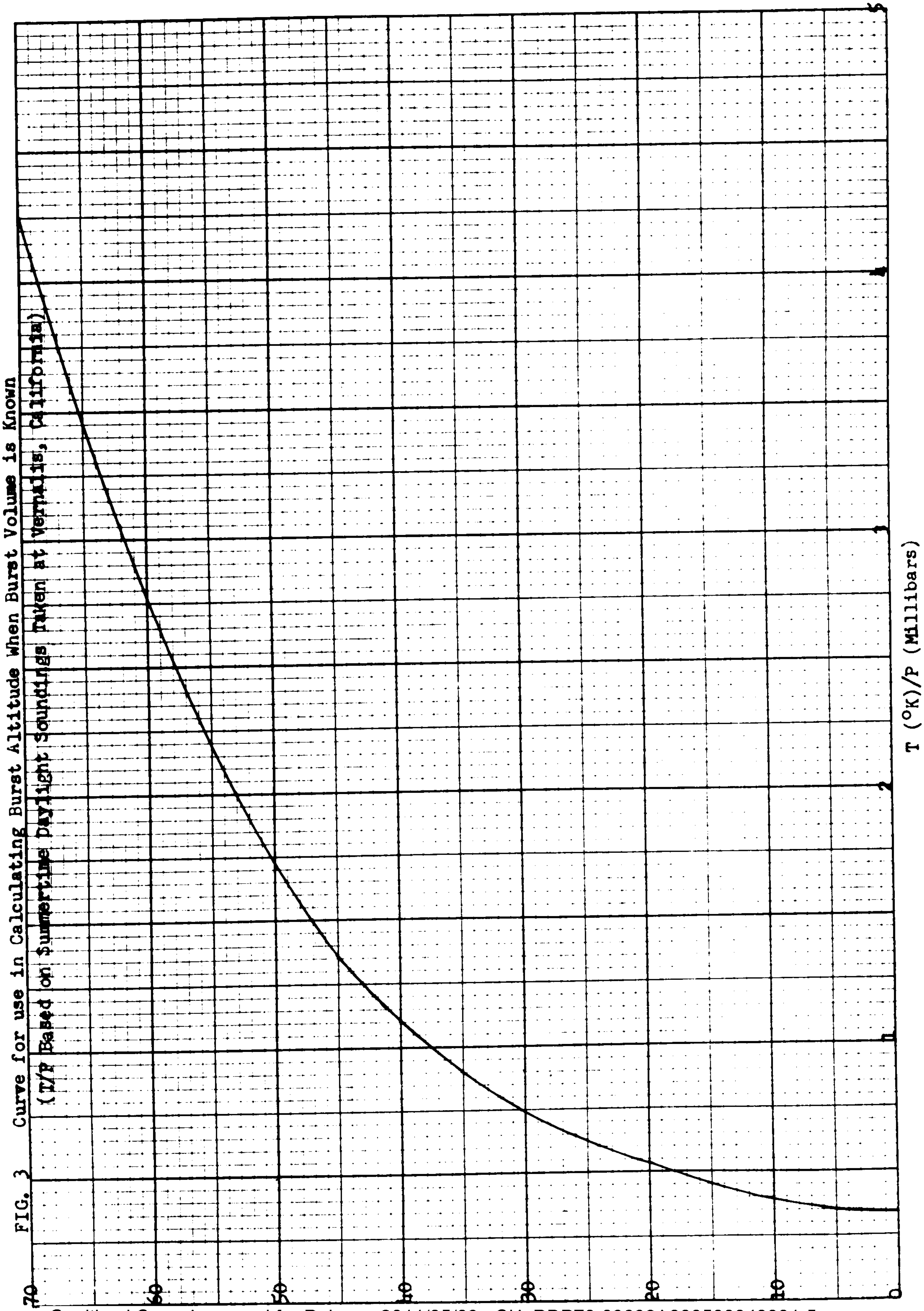


FIG. 3

Curve for use in Calculating Burst Altitude When Burst Volume is Known

(T/P Based on Summertime Daylight Soundings Taken at Vernalis, California)

NO. 325. 10 DIVISIONS PER INCH BOTH WAYS. 70 BY 100 DIVISIONS.
CODEX BOOK COMPANY, INC. NORWOOD, MASSACHUSETTS.

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

TABLE 2.) EXPECTED VERSUS OBSERVED BURST ALTITUDE

J-100 Balloons

Average Ground Burst Volume = 268 cubic feet = 96 inches Burst Diameter

Payload (lbs.)	Free Lift (grams)	N (# Moles)	Theoretical Altitude (feet)	Observed Altitude (feet)	Observed Burst Volume ($feet^3$)	Observed Burst Diameter (inches)
2	50	.0884	56,000	40,930	132	75.5
2	100	.0925	55,000	38,809	131	75.3
2	200	.1010	53,000	40,636	155	79.6
2	350	.1130	50,800	41,190	179	83.8
2	500	.1251	48,500	39,018	174	82.9
3	50	.1251	48,500	33,666	143	77.4
3	100	.1301	47,800	36,495	165	81.3
3	200	.1370	46,500	35,312	168	81.8
3	350	.1502	44,900	35,285	181	83.9
3	500	.1625	42,900	34,736	191	85.4
4	200	.1750	41,000	30,736	180	84.1
4	500	.1988	37,500	29,900	194	85.9
6	200	.2499	32,000	23,741	202	86.8
5.75	620	.2740	29,200	23,000	218	89.3

J9-10-300 Balloons

Average Ground Burst Volume = 1940 cubic feet = 185 inches Burst Diameter

5	300	.2398	80,000	58,187	803	138
5	1000	.2960	76,000	57,565	993	147
10	300	.4240	64,900	45,392	781	137
10	700	.4580	63,000	46,212	876	142
10	1000	.4810	62,000	46,220	930	144

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

The calculation of the exact bursting volume of a balloon in flight presents a problem. It is well known that the temperature of the gas inside the balloon during a daytime flight is substantially higher than that of the surrounding air. During a night flight, the temperature of the gas is equal to or slightly colder than the outside air. Therefore, in order to calculate the exact volume of a balloon in flight from the relationship PV = NRT, it is necessary that we know the exact temperature of the gas inside the balloon. Some experiments designed to measure the internal temperatures of balloons in flight have been carried out by the National Bureau of Standards which indicate that the internal temperature of balloons in the altitude range under our consideration is as follows:

Day Flight Regular Balloon*

Altitude (ft.)	External Temperature (°C)	Internal Temperature (°C) Top of Balloon	Internal Temperature (°C) Bottom of Balloon
20,000	-22.5	-20.0	-10.0
25,000	-28.0	-25.0	-19.0
30,000	-43	-37.0	-27.0
35,000	-52	-45	-36
40,000	-60	-48	-42

For night flights the Bureau of Standards reports internal temperatures as ranging from 0°C to 6°C colder than external temperatures. These flights were all carried out during the months of December and January. Presumably, flights carried out during the summer would give slightly different results. It is also suspected that flights carried out at different time of day would differ from each other. Also, it can be reasonably assumed that the internal temperature of a balloon with a low ascensional rate would differ from that of a balloon with a high ascensional rate since the faster

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

balloon spends less time exposed to the sun and is better ventilated than the slow one.

A further complication arises if one considers the variance in internal pressure which must exist. A cold neoprene balloon skin exerts more internal pressure than a warm one. Presumably, balloons flown at night possess a higher internal pressure than those flown during the day, and those flown during the day differ from each other to a degree dependent upon the amount of heating received by the film. Thus far, to our knowledge, no one has been able to measure accurately the temperature and tension of a balloon film in flight.

Thus, in the absence of precise experimental data, no attempt was made to measure the exact bursting volumes of the balloons flown during this program. Calculations were simply based on the external temperature and pressure as reported by the attached radiosonde.

*National Bureau of Standards Report #2530, June 12, 1953, Technical Report No. 8 "Measurement of The Temperatures Inside and Outside of Sounding Balloons During Flight"

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

As can be seen from Table 2, the burst diameters and, consequently the elevations attained in actual flight were considerably below those predicted on the basis of ground burst tests. Moreover, the burst diameters tend to increase as the free lift is increased and contrary to expectations, reach their greatest dimensions with the heavier rather than with the lighter loads. This phenomenon is believed to be largely a function of time and temperature. The following reasons are offered in support of this belief.

1.) EFFECT OF TIME AND TEMPERATURE

In previous low temperature testing of balloon films by the Dewey and Almy Balloon Laboratory (1) it was found that at relatively high temperatures the elongation of rubber like materials at rupture was essentially constant and relatively high, i. e., the material was soft and elastic. At very low temperatures the elongation was constant but very low, i.e., the material was hard and inelastic. In the range between the relatively high and very low temperatures the elongation decreased with the lowering of the temperature, i. e., the elastomer progressively underwent a change from a soft elastic material to a hard inelastic material. (See Table 3.) The sequence of events taking place during this phenomenon is believed to be as follows: The expansion of long chain polymers exhibiting rubber like properties is the result of two distinct movements; one the micro-movement of one molecule in relation to an adjacent molecule and the other the macro-movement of a group of molecules or a micelle in relation to another. These two movements occur simultaneously during expansion at normal temperatures. With a decrease in temperature, the macro-movement of the rubber micelles is retarded allowing greater opportunity for strain between the molecules. At this point there is a rise in modulus of the film as the polymers resist the forces tending to deform them. Consequently, some spot on the film, weaker than the rest, gives way and rupture occurs. The rise in modulus of the

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

film is attributed to the phenomenon known as crystallization wherein the movements of the carbon atoms in the polymer chain are restricted.

The relationship between extensibility and crystallization can be represented by drawing an analogy between a polymer chain and a coiled steel spring. If the spring is stretched out until all the coils are straightened, it will have a certain length. But, if we solder a few of the coils together so they cannot straighten out, then we will be unable to draw out the spring to its original length. Thus, if some of the polymers which go to make up a balloon film are prevented from uncoiling, because they are crystallized, the balloon will not achieve its maximum elongation. This, we believe, is the reason why balloons in flight do not achieve the same elongations as balloons inflated at room temperature.

Research by others (9) into the mechanism of high polymer crystallization indicates that the development of crystallinity in polymers is not instantaneous at low temperatures but progresses with time of exposure. Curves of specific volume of rubber as a function of time at temperatures below the crystalline melting point show that crystallization cannot be considered complete for long periods of time. Thus, the maximum elongation which can be attained by a balloon is inversely proportional to the time of exposure to cold temperatures.

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

TABLE 3.) COLD CABINET TESTS - PROTOTYPE NEOPRENE BALLOONS

CONTRACT C50-KO-761 #158356; #158386

BALLOON #	101	102	103	113	114	115	116
GAUGE THICKNESS (IN.)	.0040	.0042	.0040	.0045	.0040	.0045	.0045
FLACCID DIAMETER (IN.)	4.63	4.25	4.70	4.50	4.50	4.375	4.56
MAXIMUM PRESSURE (Inches H_2O)	4.8	5.1	3.0	14.7	15.6	23.0	23.0
PRESSURE AT 10 IN.-DIA.	3.0	3.5	2.1	4.7	4.7	22.0	22.0
" " 15 "	2.1	2.6	1.8	4.9	5.4	22.5	21.0
" " 20 "	1.9	2.1	1.4	10.3	12.8	---	---
" " 25 "	2.0	2.8	1.6	---	---	---	---
" " 30 "	---	---	---	---	---	---	---
PRESSURE AT BURST (In. H_2O)	2.0	2.8	2.5	14.7	15.6	23.0	19.4
DIAMETER AT BURST (IN.)	25.5	25.0	29.5	21.9	21.5	18.5	19.5
TEMPERATURE °F.	72°F	72°F	72°F	-45°F	-45°F	-76°F	-76°F
RATIO B.D./F.D.	5.52	5.89	6.21	4.87	4.78	4.23	4.28

Note that the internal pressure of the balloon rises sharply as the temperature decreases, indicating stiffening of the film. Since the area of the balloon varies as the square and the volume as the cube of the diameter, the normal tendency is for the pressure to decrease progressively with increase in diameter although there is actually an increase in linear stress in the film. However, as the balloon stiffens as a result of the low temperature, a much greater pressure is developed per unit increase in surface area.

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

TABLE 4.) PAYLOAD VS. TEMPERATURE AT BURST

J-100 Balloons

Payload	Free Lift	Average Temperature at Burst	Average Diameter at Burst
2 lbs.	200 grams	-48°C (-54.4°F)	79.6 inches
3 lbs.	200 grams	-43°C (-45.4°F)	81.8 inches
4 lbs.	200 grams	-36°C (-32.8°F)	84.1 inches
6 lbs.	200 grams	-19°C (- 2°F)	86.8 inches
		J9-10-300 Balloons	
5 lbs.	300 grams	-62°C (-79.6°F)	138 inches
5 lbs.	1000 grams	-56°C (-68.8°F)	147 inches
10 lbs.	300 grams	-59°C (-74.2°F)	137 inches
10 lbs.	700 grams	-60°C (-76.0°F)	143 inches
10 lbs.	1000 grams	-56°C (-68.8°F)	144 inches

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

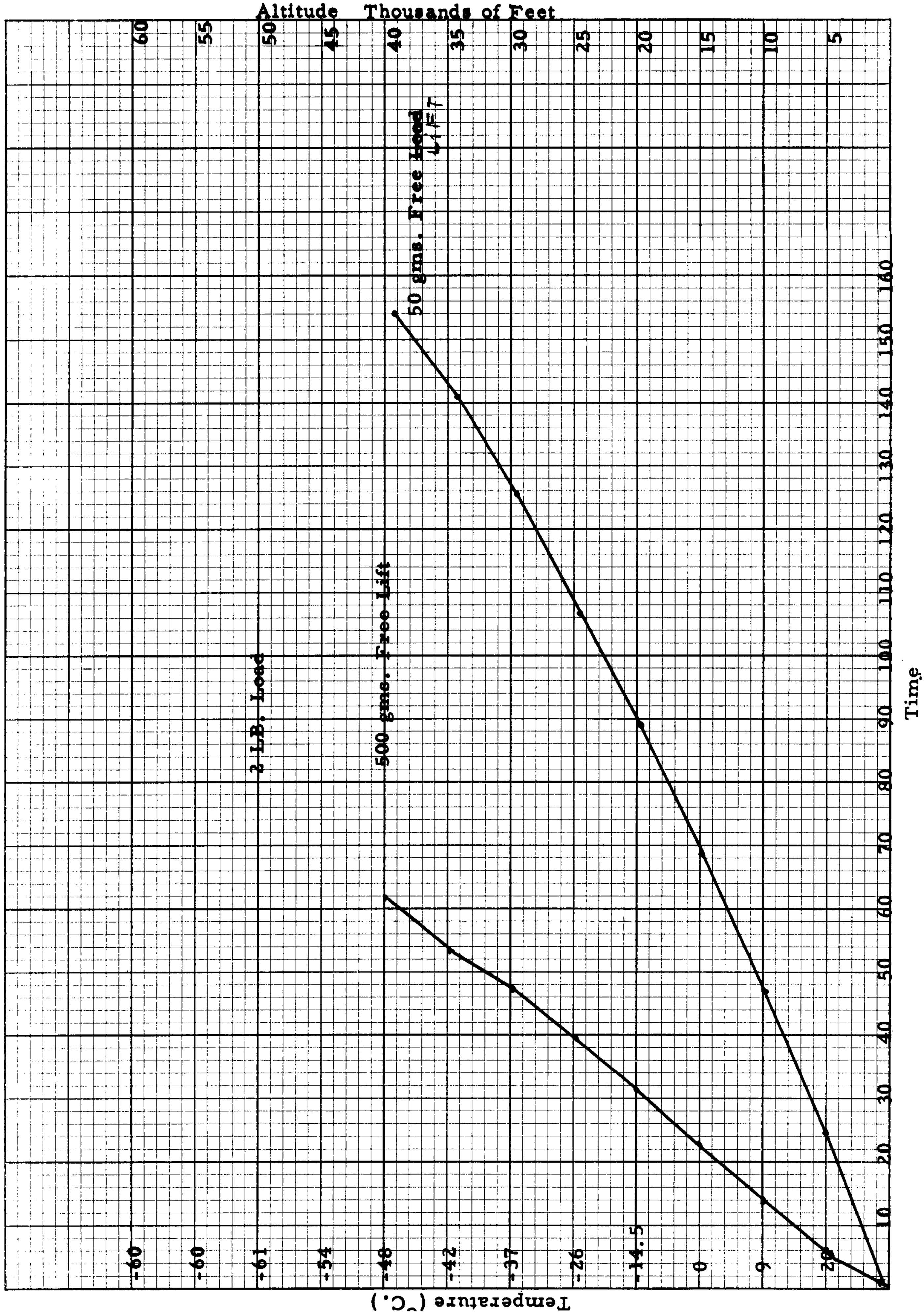


Fig. 4 Time - Altitude - Temperature Curve J-100

NO. 325 10 DIVISIONS PER INCH BOTH WAYS 70 BY 100 DIVISIONS. CODEX BOOK COMPANY INC.

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

This temperature effect is borne out in actual practice by the fact that in the case of the J-100's those balloons carrying a six pound payload attained a larger diameter than those with a two pound payload. This is in agreement with the concept of temperature effect since balloons carrying the heavier loads reach their maximum diameter at an altitude far below, and consequently much warmer than balloons carrying two pound loads. (See Table 4.) In this connection, it is interesting to note that in the case of the larger (J9-10-300) balloons the greatest burst diameters were reached by those having the highest free lift, but there was no substantial difference in burst diameters between heavy and light payloads. The "payload effect" did not appear in this case since the maxima of the larger balloons is such that very low temperatures are encountered even in the case of the balloons carrying ten pound loads.

The fact that balloons with the highest free lift attained larger burst diameters than those with the lower free lift and similar payload, can be accounted for by the fact that those balloons with a low free lift spend a considerably longer time, (See Fig. 4.) in regions of low temperature than those with high free lift, therefore allowing a greater degree of crystallization to take place with a resulting decrease in extensibility.

2.) EFFECT OF PAYLOAD:

It would seem, at first thought, that balloons in flight should burst at a smaller diameter than balloons tested on the ground, because of the strain induced on the balloon film by the payload. On the other hand the flight tests appear to indicate that the higher the payload, the larger the burst diameter. This seeming paradox was investigated via two methods: 1.) Study data on balloons flown with no payload attached. 2.) Perform experiments whereby various loads are attached to balloons burst at sea level.

Phase 1.

The U.S. Weather Bureau, as a matter of routine, carries out flight tests on production lots of Darex J-100 balloons. In these tests, the balloons carry

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

no payload and have a free lift of 500 grams. Burst altitude is determined via theodolite tracking technique. The Weather Bureau was contacted and the following flight test data were received:

TABLE 5.) FLIGHT TESTS WITH NO LOAD ATTACHED

J-100 WHITE BALLOONS

RELEASE DATE 1956	TIME	LOT 615 BURST ALTITUDE (FEET)	BURST DIAMETER (IN.)
5/27	0730	49,475	74.0
5/28	0730	56,975	85.0
5/30	0730	59.950	91.0
6/3	0730	55,050	83.5
6/7	0730	59,950	91.0
6/9	0730	56,975	85.0
6/10	0731	59,950	91.0
6/11	0731	54,230	81.0
6/16	0730	55,050	83.5
	AVERAGE	56,300	85.0

As can be seen, even balloons carrying no payload burst at a substantially lower diameter during flight than those burst at sea-level. It is also noted that these balloons burst at approximately the same diameter as those flown with a payload and the same free lift (see 500 grams free lift; 2, 3, 4, 6 lb. loads, Table 2.)

Phase 2.

To investigate further the effect of payload on burst diameter, an experiment was carried out whereby various loads were attached to a series of balloons burst at sea-level. The procedure was as follows: A J-100 balloon was fitted with a valve closure. A 2 lb. weight was suspended from the closure. The balloon was then inflated with helium until it just balanced the weight in mid-air. The

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

helium tank was then replaced with a compressed air inflation line and inflation was continued to burst thus maintaining a constant load on the balloon throughout the entire inflation. The test was repeated using a 4 and then a 6 pound load. Fifteen tests were carried out for each condition with diameters being measured at burst by means of moveable vertical rods. The results are as follows:

TABLE 6.) GROUND BURST TESTS WITH LOAD ATTACHED

LOAD	NONE	2 LBS.	4 LBS.	6 LBS.
BURST DIA. (INCHES)	95.0	94.0	96.0	85.5
	97.5	105.0	95.0	103.0
	92.0	90.0	97.0	93.0
	92.0	100.0	95.0	84.0
	97.0	90.0	95.0	94.5
	100.0	90.0	94.0	85.0
	92.5	101.5	103.0	97.0
	93.0	105.5	97.0	87.0
	101.0	91.0	82.0	97.0
	94.0	86.5	90.0	95.0
	89.0	90.0	94.0	86.0
	92.0	96.0	94.0	92.0
	97.0	90.0	85.0	97.0
	94.5	90.0	94.0	93.0
	88.0	98.0	90.0	98.0
AVERAGE	94.5	94.5	93.5	92.2

It can be seen that although there is a definite downward trend with increasing load, the difference is not great enough to fully account for the comparatively low bursts achieved in flight. It appears therefore, that the strain induced into the balloon film by the attached load is only partially, if at all, responsible for smaller than expected burst diameters and definitely does not tend to increase burst diameters with increasing load. (It will be recalled that at first glance the flight test data seemed to indicate that the heavier the payload the larger were the burst diameters attained.) This further substantiated the theory of temperature effect.

3.) EXPOSURE TO OZONE:

Ozone is formed in the atmosphere by the action of ultra-violet light from the sun on molecules of atmospheric oxygen. While the amount of ozone varies somewhat with the seasons and in different parts of the country, the daily

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

concentration at the earth's surface is from 0 - 50 parts per 100 million parts air by volume. Previous work by the Dewey and Almy Chemical Co. Balloon Laboratory revealed that neoprene balloons maintain most of their elongation properties at ozone concentrations up to 680 parts per 100 million parts air by volume (2). While it cannot be claimed conclusively that atmospheric ozone plays no part at all in decreasing the expandibility of neoprene balloons, it is considered to be a very small factor since concentrations larger than 50 parts per 100 million parts air are not usually encountered at the altitude reached by these balloons.

4.) ULTRA-VIOLET RADIATION:

The effect of ultra-violet radiation on neoprene balloons has been shown to be negligible by an experiment, performed by Barford et als (7), which made use of an "atmosphere chamber" to determine the effects of solar radiation on both natural rubber and neoprene type balloon fabrics. To simulate the conditions of a daytime flight, two large ultra-violet discharge tubes and twelve infra-red lamps were placed at distances in such a way that the total radiation was equivalent to that due to the sun in the upper atmosphere. The results of the experiment showed that natural rubber balloons are appreciably affected by solar radiation, but neoprene balloons are not affected at all.

BURSTING EXTENSION

MATERIAL	WITH RADIATION	WITHOUT RADIATION
Natural Rubber	4.7	5.6
Neoprene	4.2	4.3

A further indication that solar radiation does not deteriorate the balloon fabric during flight is obtained when we compare night flight burst volumes to day flight burst volumes. Calculated on the basis of ambient temperature and pressure it can be seen from table 7 that there is close agreement between burst volumes. However, if we take into account the fact that the

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

internal temperatures are higher during the day flights then it becomes evident that day flight balloons achieved a larger burst volume than those flown at night. Thus it can be reasoned that if sunlight did have a deteriorating effect on the balloon fabric then those balloons flown at night would have burst at a larger volume than those flown in the daytime.

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

TABLE 7.) NIGHT FLIGHTS VERSUS DAY FLIGHTS

J-100 Balloons

Payload	Free Lift	Night Flights Altitude	Night Flights Volume	Day Flights Altitude	Day Flights Volume
(Lbs.)	(Grams)	(Feet)	(Cubic Feet)	(Feet)	(Cubic Feet)
3	200	38,064	188	31,361	146
3	200	32,214	149	38,661	186
3	200	36,197	170	39,498	192
3	200	37,103	179	36,165	174
3	200	34,695	162	30,876	140
3	200	34,488	162		
3	200	37,795	179		
3	200	38,854	172		
3	200	35,804	167		
3	200	36,414	172		
	Average	35,963	170	35,312	168

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

5.) ATMOSPHERIC TURBULENCE EFFECT ON BURST DIAMETER:

It is not felt that atmospheric turbulence contributes to any large extent to lowering the extensibility of neoprene balloons, except perhaps during the initial phase of the ascent where, as the balloon rises against the dense air, a deformation of the upper hemisphere known as "dishing in" occurs. As a result of the internal restoring forces and the decrease in velocity, the balloon does not maintain its deformed shape and springs back to its original spherical shape. Once the balloon passes this stage and ascends into thinner and colder air, little or no deformation occurs since at the colder temperatures and higher elongation the balloon possesses greater rigidity.

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

C. PERFORMANCES OF AGED BALLOONS

It is well known that meteorological balloons, after years of shelf-storage, deteriorate to some extent. The term "aging" as applied to balloon films describes various physical and chemical changes that begin when manufacture is completed and continue during storage until the product is no longer suitable for its intended use.

The chemical changes in vulcanized rubber that take place with aging are attributed to three possible reactions:

1. Chain scission - the long molecular chains, which form the major structure of the polymer, may be cut into smaller pieces. This reduces the molecular weight of the polymer and, as molecular weight decreases, the tensile strength of the rubber is lowered and ultimately is lost completely. If "chain scission" occurs extensively in balloons, they will soften and appear to have become unvulcanized. This phenomenon is known to occur in natural rubber and is called "reversion". Neoprene, however, is very resistant to this type of degeneration and in this respect is superior to natural rubber as a balloon film.

2. Age Crystallization - the linear molecular chains may be tied together by cross-links. The process of cross-linking due to aging is thought to be due to the effect of oxygen reacting with the unsaturated groups in the polymer. This process, if it occurs extensively, results in a decrease in extensibility and an increase in the stiffness of the film. In the case of a balloon, if the process of crystallization has not progressed too far, this condition may be reversed, through the action of heat, by immersing the balloon in hot water (200°F) for a few minutes prior to use.

3. The nature of chemical side groups along the molecular chains may

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

be modified. In case of neoprene, chlorine may be split off to form HCL.

These reactions have received considerable attention by many investigators with the results that compounding techniques have been improved to a point where any deterioration of a neoprene balloon film due to aging has been reduced to a very small minimum and has been mentioned above, can normally be reversed by "preheating".

Since it is operationally desirable to use balloons without the necessity of preheating, a series of flight tests was carried out in an effort to determine at which point the J-100 balloons begin to lose their extensibility. The results of these tests are as follows.

TABLE 8.) AGED BALLOON FLIGHTS J-100 WHITE BALLOONS

LOAD LBS.	LIFT (GRAMS)	AGE	PREHEAT	AVERAGE ALTITUDE (FT)	AVERAGE BURST DIA. (INS.)
3	200	3 MOS	NONE	35,312	81.8
3	200	3 MOS	5 MIN. @ 200 °F	34,103	80.4
3	200	13-15 MOS	NONE	32,518	79.3
3	200	19-20 MOS	NONE	31,367	78.1
3	200	24 MOS	NONE	20,820	69.2
3	200	24 MOS	5 MIN. @ 200 °F	31,227	77.5

The foregoing data indicates that the J-100 balloons maintain their maximum extensibility without the necessity for preheating for a period of time well over 12 months.

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

D. ADVERSE WEATHER FLIGHTS

For operational purposes it is essential to have a knowledge of the performance characteristics of balloons under adverse weather conditions for comparison with performance under clear weather conditions. This phase of the test program was designed to study the performance of J-100 balloons under the following adverse conditions: Heavy clouds, daytime; light clouds, daytime; rain, daytime; heavy clouds, nighttime. The results of this series of tests is as follows:

TABLE 9.) ADVERSE WEATHER VS CLEAR WEATHER FLIGHTS

ALL FLIGHTS HAVE 3 LB. LOAD AND 200 GRAM FREE LIFT

TIME	WEATHER	ALTITUDE (FT.)
Day	Clear	35,310
Day	Heavy Clouds	38,731
Day	Light Clouds	36,004
Night	Clear	35,663
Night	Heavy Clouds	34,013

The data in TABLE 9 indicates that burst altitudes of J-100 balloons carrying the same payload and free lift are not affected by variations in cloud coverage. (Flight scheduling was such that only one flight was made successfully during a very light rain. This flight reached an altitude of 39,751 feet. Another flight launched in heavy rain was forced down by a sudden squall shortly after launching. By the time a second flight was prepared, the rain had ceased, thus it was not determined whether the balloon was forced down by the momentum of the rain or because of an error in making up the free lift.)

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

E. ASCENSIONAL RATE

1.) Theoretical Considerations

When a balloon is released from rest (velocity = 0) the forces acting on it are its weight and the buoyant force of the air. Since balloons are filled with a lighter-than-air gas, in this case hydrogen, the resultant force is an upward one and is expressed by:

$$F = V\,(Da - Dh) - (w + W) \qquad (1)$$

Where: F = Free lift (grams) or upward force.

V = volume of balloon (c.c.)

Da = density of air (grams/c.c.)

Dh = density of hydrogen (grams/c.c.)

w = weight of balloon (grams)

W = payload (grams)

If $F > 0$ the balloon is accelerated upward and as a result of this acceleration it acquires an upward velocity and therefore experiences a retarding force. The magnitude of the retarding force is dependent on the properties of the fluid (density, viscosity) and on the velocity, shape, and size of the body passing through the fluid. Through an analysis beyond the scope of this report the law of motion of a body in a turbulent fluid is given by*:

$$F = (k/g)\; Da\; v^2\, A \qquad (2)$$

Where: F is the retarding force in grams; k a dimensionless constant depending on the shape of the body, in this case a sphere, and on the Reynold's number; g the acceleration of gravity; Da the density of the air in grams/c.c.; v the velocity in cm/sec; and A the cross-sectional area in cm^2 of the body

* Clarke and Korff (Journal of the Franklin Institute "The Radiosonde" Oct. 1941)

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

normal to the direction of flow.

As the velocity increases, the retarding force also increases and eventually a velocity is reached such that the upward force and the retarding force are equal. The balloon then ceases to accelerate and moves with a constant velocity called its terminal velocity. This velocity can be found by setting the upward force equal to the retarding force.

Since $V = 4/3\,\pi r^3$ and $A = \pi r^2$ where r is the radius of the balloon in cm. we can rewrite equations (1) and (2) thus:

$$F = 4/3\,\pi\, r^3\ (Da-Dh) - (w + W) \qquad \text{(eq. 1)}$$

$$F = (k/g)\ Da\ v^2\ \pi\ r^2 \qquad \text{(eq. 2)}$$

Combining them we get:

$$\frac{F + w + W}{F} = \frac{4\ \pi\ r^3\ (Da-Dh)}{3\ \pi\ r^2\ \ Da\ v^2}\ \frac{g}{k}$$

or: $$v^2 = 4/3\ g\ \left(\frac{Da-Dh}{Da}\right)\ \left(\frac{F}{F+w+W}\right)\ \frac{r}{k} \qquad \text{(eq. 3)}$$

From equation (1) we see that

$$V = \frac{F + w + W}{Da-Dh} = 4/3\ \pi r^3 \text{ thus } r = \left(3/4\pi\ \ \frac{F+w+W}{Da-Dh}\right)^{1/3} \qquad \text{(eq. 4)}$$

Replacing r in eq. 3 by eq. 4 we get:

$$v^2 = 4/3\ g\ \left(\frac{Da-Dh}{Da}\right)\ \left(\frac{F}{F+w+W}\right)\ \left(\frac{\left(3/4\pi\ \ \frac{F+w+W}{Da-Dh}\right)^{1/3}}{k}\right) \qquad \text{(eq. 5)}$$

Solving equation (5) for v we get

$$v = \frac{85}{(k)^{1/2}}\ \ \frac{(F)^{1/2}}{(F+w+W)^{1/3}} \text{ cm./sec. at sea level} \qquad \text{(eq. 6)}$$

Values of the resistance coefficient, k, depend on the shape of the

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

body, in this case a sphere, and on the Reynold's number, $R = \frac{vr}{u}$, where v is the velocity in cm/sec.; r is the radius in cm.; u is the kinematic viscosity (viscosity/density) of the fluid, air in this case.

It is evident that:

(a) according to equation (3), the initial rate of rise depends largely on the values of r and k for each balloon.

(b) the properties of the atmosphere are continuously changing with each increase in altitude (density, viscosity and temperature decrease with altitude).

(c) The properties of the atmosphere are variable at different locations, time of day and season of the year. (Temperature, convection currents, winds, solar radiation etc. are variable.)

(d) The properties of the balloon are continuously changing with altitude (radius increases with altitude, membrane tends to stiffen with decreasing temperature, deformation of shape during ascent, etc.)

Thus it can be seen that the ascensional rate will not necessarily remain constant throughout the flight nor necessarily be the same for a given balloon at all times and places.

Since R, the Reynold's number, depends largely on the value of density of the air, it can be seen that the value of R will decrease continuously with each increase in altitude. Examination of figure 5 (k versus Reynold's number) reveals that, for balloons starting off with a Reynold's number of less than about 1.2×10^5, k will remain constant throughout the flight and according to equation (3) velocity will be proportional to the square root of the radius, hence will increase with increasing altitude. In those cases where R is greater

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

than about 1.5×10^5, k will not remain constant but at some point during the flight will increase abruptly when R becomes less than about 1.2×10^5. Balloons of this type will have a lower rate of rise in the upper portion of their flight than in the lower portion. If R is very much greater than 4×10^5 then it can be seen that the abrupt change in k may not occur before the flight terminates.

It has been reported by some investigators (8) who have studied ascensional rates of various sizes and types of meteorological balloons that the ascensional rate.

(1) is greater during the day than during the night. (We believe that this phenomenon is due to the effect of solar radiation on the temperature of the gas inside the balloon and the tension of the balloon film during flight. Since the gas is warmer at any given altitude during the day than during the night, the net result is a larger volume during the day and hence from equation (1) free lift is greater during the daytime at any given altitude.)

(2) is greater in the afternoon than in the morning and is affected by local topography. Presumably, these phenomena are due to the variations, with time and place, of convection currents and temperature.

(3) is affected by changes in wind speed and direction.

(4) is related to the material and shape of the balloon.

(5) is related to the kind of gas used in filling the balloon.

In view of all these factors, it is evident that any formula based purely on the physical laws of motion to predict the rate of rise of an expansible balloon can at best be only a close approximation since it is impossible, within the scope of this report, to take into account all of the variables included

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

in the motion of a dynamic body in a dynamic fluid.

However, for practical purposes, we may utilize the data obtained from the flight tests in Task II of this report and arrive at a general formula for the Darex J-100 balloons which will be accurate in most cases to within 10% of the average actual rate.

II. Experimental Data:

(a) Average rate or rise for the J-100 balloons in the range under consideration; the empirically derived formula for rate of rise is:

$$340 \frac{(F)^{1/2}}{(F+w+W)^{1/3}} \text{ ft. per minute = average rate of rise}$$

For J9-10-300 balloons carrying payloads in the range of 5 lbs., the empirically derived formula is:

$$420 \frac{(F)^{1/2}}{(F+w+W)^{1/3}} \text{ ft. per minute = average rate of rise}$$

For J9-10-300 balloons carrying payloads in the range of 10 lbs. the empirically derived formula is:

$$500 \frac{(F)^{1/2}}{(F+w+W)^{1/3}} \text{ ft. per minute = average rate of rise}$$

A comparison between the ascent rates predicted by these formulae and the actual ascent rates observed in flight tests indicates fairly close agreement, except of course in the case of night flights where, as has been previously mentioned, the observed ascent rates were slower than theoretical. It can also be seen from Table II. that early morning flights tend to be slower than afternoon flights in most cases.

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

(b) Incremental rate of rise

A study of the incremental ascensional rate characteristics recorded in Chart A. reveals the following:

(1) In the case of the J9-10-300 balloons

(a) In general the rate of rise is greater in the lower portion of the flight than in the upper portion. This is thought by us to be due to the relationship between Reynold's number and the coefficient of friction. That is, we believe the coefficient of friction increased abruptly at a point during flight when the Reynold's number decreased below about 1.2×10^5.

(2) In the case of the J-100 balloons

(a) With the lower free lifts, the ascent rate tends to increase with altitude. We believe this to be due to the fact that these balloons start off with a low Reynold's number thus k remains constant, hence velocity becomes proportional to radius. Another factor may be super-heating of the gas due to excess time in flight.

(b) In the case of the cloudy weather flights the rate of rise appears to be initially slightly slower than the latter part of the flight. It is believed that this is due to the lack of direct solar radiation received by the balloon from ground level until it breaks through the cloud layer.

(c) Ascent rate during night flights is slightly higher in the initial part of the flight than in the latter part. We believe

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

this is due to the tendency of the balloon film to stiffen in the low temperatures of the upper portion of the flight, as well as the fact that the internal temperature is slightly lower than ambient, which in our opinion brings about a slight decrease in free lift.

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

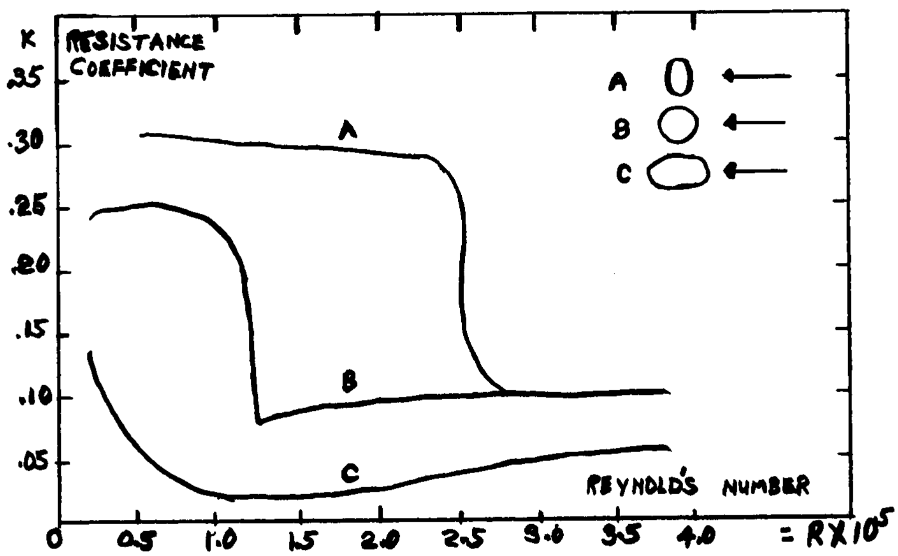


Fig. 5. Variation of resistance coefficient k with Reynold's Number R vr/v, for a sphere (B) and for ellipsoids of revolution with their major axes parallel (C) and perpendicular (A) to the direction of motion through the air.

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

TABLE 10.) RELATIONSHIPS USED IN CALCULATING RATE OF RISE FORMULA

Density of air at 20 °C $= 1.025$ grams/liter

Density of hydrogen $=$ .09 grams/liter

Gravitational constant $=$ 980 cm./sec.^{2}

Viscosity of air $=$ $.0181 \; 10^{-2}$ grams/cm.sec.

Kinematic viscosity of air $=$ viscosity/density $= .151$ cm.^{2}/sec.

$$\text{Reynold's number} = \frac{\text{veloc. of balloon(cm. per sec.)} \;\; \text{rad. of balloon (cm.)}}{\text{Kinematic viscosity (cm.}^2\text{/ sec.)}}$$

Figure 5. Graph Reynold's number vs coefficient of friction.

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

TABLE II.) THEORETICAL VERSUS OBSERVED ASCENSIONAL RATES

J9-10-300 BALLOON

TIME OF DAY	GRAMS FREE LIFT	GRAMS GROSS LIFT	THEORETICAL FT./MIN.	OBSERVED FT./MIN.	PAYLOAD
1:30 P.M.	300	2920	510	584	5 lbs.
9:00 A.M.	300	2920	510	509	"
6:50 A.M.	300	2920	510	433	"
1:10 P.M.	300	2920	510	526	"
			Average	513	
11:30 A.M.	300	5190	500	483	10 lbs.
1:30 P.M.	300	5190	500	478	"
5:26 P.M.	300	5190	500	519	"
11:00 A.M.	300	5190	500	548	"
			Average	507	
12:21 P.M.	700	5590	745	722	10 lbs.
8:30 A.M.	700	5590	745	596	"
10:00 A.M.	700	5590	745	697	"
11:40 A.M.	700	5590	745	704	"
			Average	680	
3:32 P.M.	1000	3620	865	815	5 lbs.
6:00 P.M.	1000	3620	865	827	"
8:30 A.M.	1000	3620	865	744	"
11:40 A.M.	1000	3620	865	834	"
			Average	805	
11:50 A.M.	1000	5885	875	879	10 lbs.
1:45 P.M.	1000	5885	875	924	"
4:15 P.M.	1000	5885	875	914	"
5:55 A.M.	1000	5885	875	737	"
			Average	862	

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

J-100 BALLOONS

Flight Conditions Day Clear	Time of Day	Grams Free Lift	Grams Gross Lift	Theoretical Ft./Min.	Observed Ft./Min.	Pay-Load
"	8:30 A.M.	50	1080	235	251	2 Lbs.
"	9:30 A.M.	50	1080	235	252	"
"	9:12 A.M.	50	1080	235	276	"
"	9:30 A.M.	50	1080	235	257	"
				Avg.	260	
"	8:45 A.M.	50	1535	207	187	3 Lbs.
"	12:40 P.M.	50	1535	207	273	"
"	8:30 A.M.	50	1535	207	220	"
"	8:15 A.M.	50	1535	207	227	"
"	8:42 A.M.	50	1535	207	228	"
				Avg.	~~232~~ 227	
"	10:40 A.M.	100	1130	325	337	2 Lbs.
"	1:05 P.M.	100	1130	325	342	"
"	3:40 P.M.	100	1130	325	322	"
"	11:35 P.M.	100	1130	325	336	"
"	2:45 P.M.	100	1130	325	373	"
				Avg.	342	
"	8:30 A.M.	100	1585	290	312	3 Lbs.
"	8:25 A.M.	100	1585	290	324	"
"	9:00 A.M.	100	1585	290	308	"
"	10:45 A.M.	100	1585	290	326	"
"	1:15 P.M.	100	1585	290	317	"
				Avg.	317	
"	11:00 A.M.	200	1230	446	434	2 Lbs.
"	8:30 A.M.	200	1230	446	417	"
"	11:25 A.M.	200	1230	446	452	"
"	3:30 P.M.	200	1230	446	453	"
"	1:30 P.M.	200	1230	446	449	"
				Avg.	441	
"	11:00 A.M.	200	1685	405	423	3 Lbs.
"	2:00 P.M.	200	1685	405	405	"
"	3:55 P.M.	200	1685	405	399	"
"	8:55 A.M.	200	1685	405	374	"
"	10:55 A.M.	200	1685	405	405	"
				Avg.	401	

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

J-100's (Continued)

Flight Conditions Day Clear	Time of Day	Grams Free Lift	Grams Gross Lift	Theoretical Ft./Min.	Observed Ft./Min.	Pay-load
"	11:50 A.M.	200	2138	372	433	4 Lbs.
"	10:45 A.M.	200	2138	372	429	"
"	1:50 P.M.	200	2138	372	363	"
"	3:55 P.M.	200	2138	372	408	"
"	8:40 A.M.	200	2138	372	363	"
				Avg.	400	
"	1:45 P.M.	200	3047	315	344	6 Lbs.
"	3:30 P.M.	200	3047	315	382	"
				Avg.	363	
"	1:00 P.M.	320	3047	420	477	5.7 Lbs.
"	10:40 A.M.	320	3047	420	465	"
"	2:00 P.M.	320	3047	420	480	"
				Avg.	474	
"	2:15 P.M.	350	1380	570	558	2 Lbs.
"	4:00 P.M.	350	1380	570	553	"
"	3:45 P.M.	350	1380	570	525	"
"	11:45 A.M.	350	1380	570	556	"
"	2:15 P.M.	350	1380	570	561	"
				Avg.	550	
"	12:05 P.M.	350	1835	520	545	3 Lbs.
"	11:00 A.M.	350	1835	520	512	"
"	9:00 A.M.	350	1835	520	510	"
"	10:00 A.M.	350	1835	520	542	"
				Avg.	527	
"	10:30 A.M.	500	1530	660	675	2 Lbs.
"	1:00 P.M.	500	1530	660	649	"
"	3:05 P.M.	500	1530	660	627	"
"	5:00 P.M.	500	1530	660	611	"
"	10:30 P.M.	500	1530	660	655	"
				Avg.	643	

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

J-100's (Continued)

Flight Conditions Day Clear	Time of Day	Grams Free Lift	Grams Gross Lift	Theoretical Ft./Min.	Observed Ft./Min.	Pay-Load
"	3:00 P.M.	500	1985	600	680	3 Lbs.
"	2:20 P.M.	500	1985	600	650	"
"	10:15 A.M.	500	1985	600	660	"
"	10:15 A.M.	500	1985	600	598	"
"	3:32 P.M.	500	1985	600	585	"
				Avg.	635	
"	8:34 A.M.	500	2440	565	580	4 Lbs.
"	8:50 A.M.	500	2440	565	530	"
"	8:50 A.M.	500	2440	565	535	"
				Avg.	548	
"	10:00 A.M.	620	3350	570	656	5.75 Lbs.
"	3:04 P.M.	620	3350	570	623	"
"	1:05 P.M.	620	3350	570	674	"
				Avg.	651	

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

J-100's (Continued)

Flight Conditions Night Clear	Time of Day	Grams Free Lift	Grams Gross Lift	Theoretical Ft./Min.	Observed Ft./Min.	Pay-load
"	11:00 P.M.	200	1685	405	299	3 Lbs.
"	9:00 P.M.	200	1685	405	315	"
"	9:30 P.M.	200	1685	405	346	"
"	11:45 P.M.	200	1685	405	347	"
"	2:03 A.M.	200	1685	405	291	"
"	4:25 A.M.	200	1685	405	308	"
"	1:00 A.M.	200	1685	405	340	"
"	3:20 A.M.	200	1685	405	338	"
"	10:40 P.M.	200	1685	405	344	"
"	1:00 A.M.	200	1685	405	325	"
				Avg.	325	
Night Overcast	9:30 P.M.	200	1685	405	308	3 Lbs.
"	9:15 P.M.	200	1685	405	383	"
"	9:00 P.M.	200	1685	405	357	"
				Avg.	349	
Heavy Day Clouds	11:50 A.M.	200	1685	405	420	3 Lbs.
"	3:30 P.M.	200	1685	405	416	"
"	1:30 P.M.	200	1685	405	446	"
"	11:30 A.M.	200	1685	405	435	"
"	2:00 P.M.	200	1685	405	427	"
				Avg.	429	
Light Day Clouds	3:20 P.M.	200	1685	405	425	3 Lbs.
"	9:00 A.M.	200	1685	405	400	"
				Avg.	412	

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

F.) ROOM TEMPERATURE DIFFUSION RATES OF J-100 BALLOONS INFLATED TO FLIGHT DIMENSIONS

The permeation of gases through membranes has been the subject of considerable experimental investigation. This process of permeation of a gas through a film is generally regarded as a combination in series of ; a) adsorption and solution by the gas into the membrane at one surface; b) diffusion of the gas through the body of the membrane and; c) dissolution and desorption of the diffusing gas out of the membrane at the other surface. (5). The rate at which a volume of gas will diffuse through a membrane is dependent on temperature; pressure; area of membrane; and thickness of membrane. The rate of diffusion is proportional to the temperature, pressure difference and the area and inversely proportional to the thickness of the film. Because permeability is a combination of the two functions of solubility and microporosity of the film, it is evident that the rate of permeability will rise and fall with the temperature. An increase in temperature increases the vibrations of the molecules making up the polymeric membrane. If this is regarded as a multi-layered reticulum, then it can be visualized that the interstices or holes are opened and closed more often or possibly to a greater extent to increase the possibility of the passage or diffusion of the molecules of gas through them. An increase in temperature also brings about an increase in the kinetic energy of the gas molecules allowing a greater frequency of collisions between the gas molecules and the walls of the film.

In the case of meteorological balloons it is well known that loss of lift due to permeation in flight is so small as to be negligible (4). This is understandable since as the balloon rises into regions of low temperature both the solubility and the kinetic energy of the gas are greatly decreased and the porosity of the film itself is markedly decreased due to stretching and orientation of the polymeric structure of the membrane. But, although it is generally conceded that permeation is a negligible factor during actual flight, it is operationally desirable to

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

know how much free lift would be lost to permeation, by a balloon inflated to flight dimensions and allowed to stand at room temperature for a period of time prior to launching. With a knowledge of the diffusion rate at room temperature of a balloon carrying a specified payload, and free lift to attain a desired ascensional rate, the free lift could be increased to compensate for future loss in cases where it is desirable or necessary to delay the launching of an inflated balloon. With this in view, an experiment was conducted whereby loss of lift due to permeation was measured, over a period of time, for J-100 balloons carrying payloads of 1, 2, 3, 4, and 6 pounds.

The procedure for the experiment was as follows:

Several J-100 balloons with 1, 2, 3, 4, and 6, lb. loads attached were inflated with hydrogen to a point where the load was just balanced in mid-air. The balloons were checked at intervals of ten minutes and ballast was removed to restore the balance when lift was lost. The removed ballast was weighed and recorded as grams of lift lost. This procedure was continued for several hours with the following results:

TABLE 12.) LOSS OF LIFT DUE TO PERMEABILITY J-100 WHITE BALLOONS

Payload	Grams of lift lost (10 minute intervals) 20°C													Avg. Loss (gms.) per hour
1 lb.	0.6	1.6	2.6	3.0	3.2	1.7	0.0	1.7	2.0	2.2	2.2	2.2	2.0	11.4
2 lb.	0.9	3.7	2.3	3.3	2.1	2.7	2.6	3.3	2.6	6.3	6.3	2.5	2.7	17.5
3 lb.	1.9	3.1	4.6	4.6	3.8	4.8	5.0	5.3	4.4	4.4	4.4	5.3	5.3	25.8
4 lb.	0.0	5.9	5.7	5.7	7.4	4.6	5.9	5.9	7.2	7.2	5.1	6.8	7.0	33.0
6 lb.	0.0	0.0	7.3	7.3	9.2	9.9	8.8	12.3	8.5	8.5	10.2	11.4	10.2	48.4

It can be seen from Table 12, that the loss of lift in the first ten minutes is very small regardless of the load the balloon is carrying. We feel that this effect is due to two factors.

1.) During inflation the gas is cooled by adiabatic expansion and takes time to reach equilibrium with room temperature.

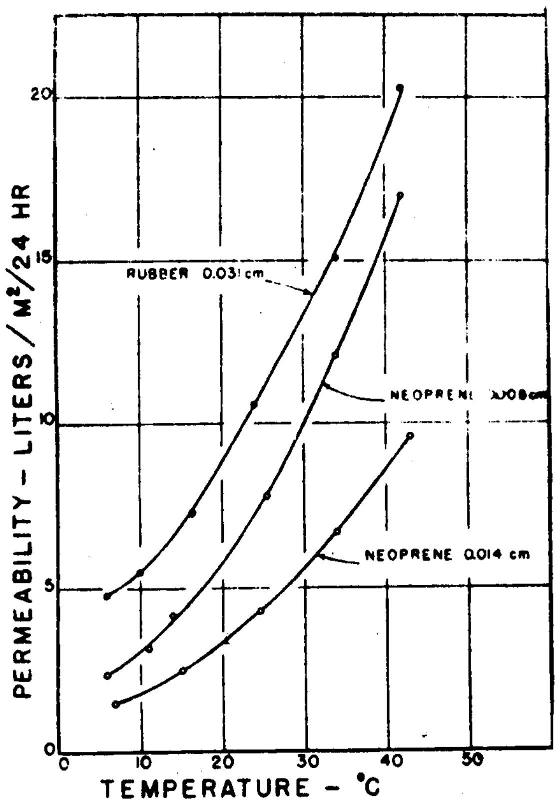
2.) There is a short build-up period during which the film is not

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

saturated with the dissolving gas. Once the proper concentration gradient is built up, the gas will diffuse through the film at a fairly constant rate.

The discrepancy in the amount of lift lost between 10 minute intervals is probably due to minor disturbances in the air caused by slight updrafts or downdrafts in the area where the experiment was conducted. However, since these conditions are similar to those encountered in the field, it is believed that the average loss of lift as determined by the experiment is representative of the actual state of affairs regarding the practical relationship between diffusion and free-lift.



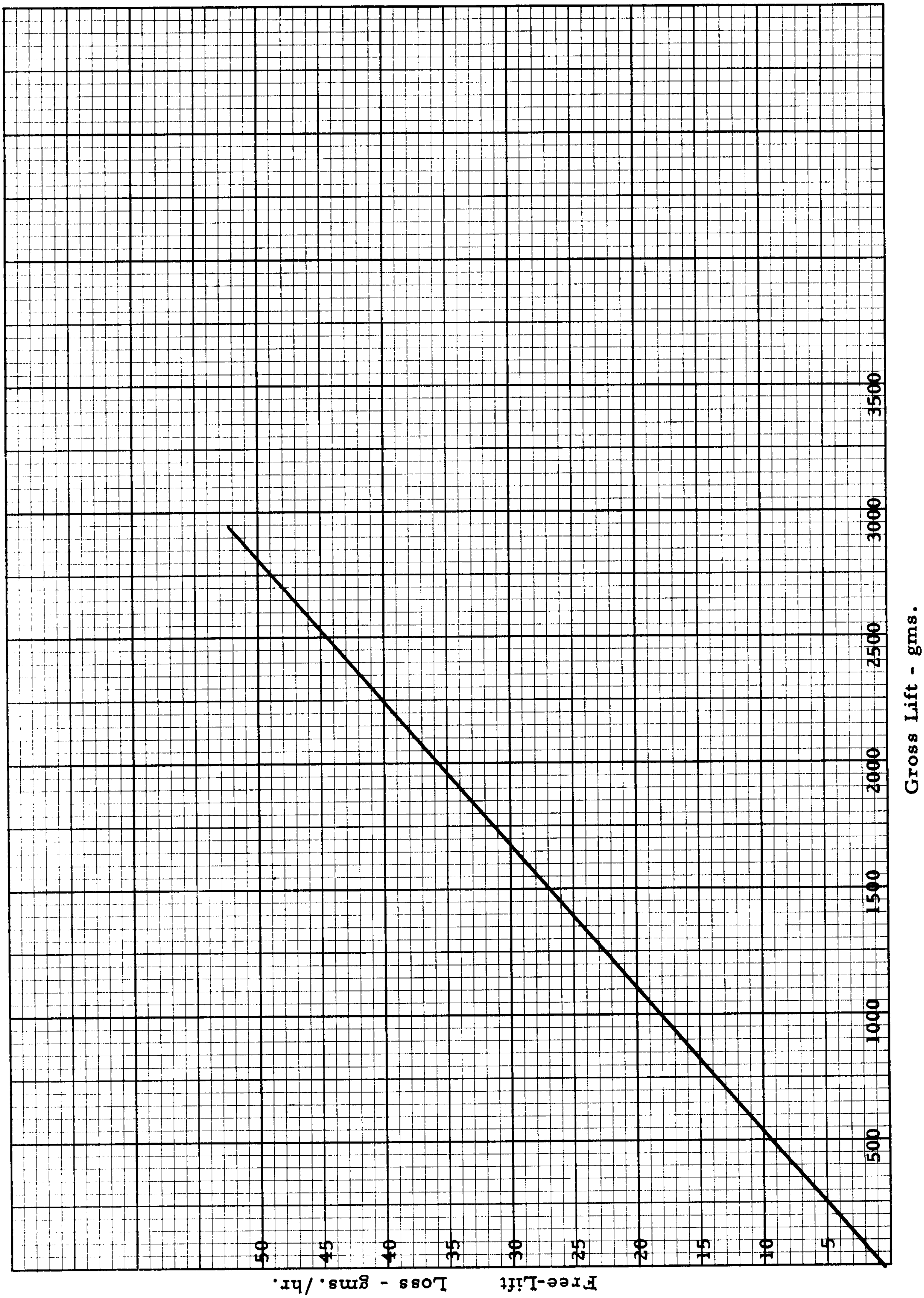
Relation between permeability to hydrogen and temperature.

For the sake of convenience in operational use, a graph has been prepared wherein loss of lift in grams per hour has been plotted as a function of gross lift. (See figure ~~5.~~ 6)

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

NO. 315. 10 DIVISIONS PER INCH BOTH WAYS. 70 BY 100 DIVISIONS. CODEX BOOK COMPANY, INC. NORWOOD, MASSACHUSETTS

Fig. 6. Relation between Gross Lift - Loss of Free Lift due to Diffusion (25°C)



Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

G.) ADIABATIC COOLING OF INFLATION GAS

Two attempts were made to measure the temperature of the inflation gas versus room temperature immediately after inflation. The balloons used in the experiment were inflated at a regulator pressure of 25-50 p.s.i.

Attempt #1. A thermometer was inserted through the valve of the neck-closure into the balloon immediately after inflation. It was oberved that the temperature inside the balloon was 1°C. below that of room temperature.

Attempt #2. Since it was felt that the thermometer used in Attempt #1, was not sensitive enough to accurately measure the gas temperature, a second attempt was made using a radiosonde. This was accomplished by attaching a long wire to the thermistor and inserting it into the balloon before inflating. Thus the temperature of the gas was measured while the balloon was being inflated. Again a difference of only 1°C. was noted.

From these experiments it was concluded that variation in lift due to adiabatic cooling of the gas was not a large factor in determining free-lift in the case of a J-100 balloon.

H.) CONCLUSION

It is concluded from the foregoing ground and flight test data that the characteristics of the J-100 and J9-10-300 gram balloons are:

1. Burst Diameter:

   a.) Ground burst diameters are somewhat larger than flight test burst diameters because of the effects of time and temperatures. (96 inches vs. 77-85 inches).

   b.) Balloons having a high ascensional rate attain larger burst diameters than balloons having a low ascensional rate. (77 inches vs. 85 inches).

   c.) Balloons carrying a payload of sufficient magnitude to preclude their ascending to high altitudes burst at a larger

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

diameter than balloons capable of ascending to high altitudes because of the difference in temperatures.

d.) Balloons can be stored for a period of 12 to 15 months without the necessity of pre-heating.

2. Burst Altitude:

a.) In accordance with the gas laws, balloons with light payloads ascend to higher altitudes than those with heavy payloads. However, because of the relationship between time, temperature and burst diameter, balloons with a given payload and low free-lift will reach approximately the same altitude as a similar balloon with the same payload and high free-lift. The altitudes attained by the balloons under consideration range from:

(1) 23,000 feet with a 6 lb. payload to 40,000 feet with a 2 lb. payload using J-100 balloons.

(2) 45,000 feet with a 10 lb. payload to 58,000 feet with a 5 lb. payload using J9-10-300 balloons.

b.) The presence of clouds does not affect the burst altitudes attained by J-100 balloons.

c.) J-100 balloons flown at night reach the same altitude as those flown during the day.

3. Ascensional Rate:

a.) It has been shown that the ascensional rate of meteorological balloons is proportional to $\frac{(\text{Free Lift})^{1/2}}{(\text{Gross Lift})^{1/3}}$

and that for a J-100 balloon the theoretical rate of rise is equal to $340\,\frac{(\text{Free Lift})^{1/2}}{(\text{Gross Lift})^{1/3}}$ feet per minute and for a J9-10-300 balloon the theoretical rate of rise is equal to 546

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

$\frac{(\text{Free Lift})^{1/2}}{(\text{Gross Lift})^{1/3}}$ feet per minute. X420 FOR 5LB. PAYLOAD X500 FOR 10LB PAYLOAD

b.) Because of certain uncontrollable variables in the nature of the fluid and the body in motion, it was found that the above formulae are only accurate to within 10% of all the actual rate of rise, therefore

c.) reliance must be based on experimental data if greater accuracy is desired.

d.) Night flights rise more slowly than day flights.

e.) Early morning flights rise more slowly than afternoon flights.

f.) J-100 balloons flown under conditions of overcast skies have the same average ascensional rate as those flown in clear weather.

g.) Aged balloons have the same ascent rate as fresh balloons.

4. Permeability:

a.) Permeability of a gas through a neoprene membrane is a solubility phenomenon.

b.) The rate of permeability is directly proportional to temperature, surface area and pressure difference and inversely proportional to the thickness of the film.

c.) Because of the rapid decrease in temperature during flight, the loss of lift due to diffusion during flight is very small, becoming negligible at high altitudes.

d.) Because of a lag period, balloons inflated to flight dimensions and held at ground level will not lose any lift due to diffusion in the first ten minutes. However,

e.) if balloons are inflated and held at room temperature for an extended period of time before launching they will lose from

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

11.4 grams of lift per hour for a 2 lb. load to 48 grams of lift per hour for a 6 lb. load. The rate of diffusion increases as the load is increased because the film is thinner with the heavier loads.

5. Adiabatic cooling of inflation gas

a.) If balloons are inflated at a regulator pressure of 25-50 p.s.i. there will be no loss of lift due to adiabatic cooling of inflation gas.

6. Uniformity of performance

The data obtained from the flight test program indicates that the average range in burst altitude for the J-100 balloons is 5,582 feet and the average standard deviation is 2,610 feet.

For the J9-10-300 Balloons, the average range is 7,400 feet and the average standard deviation is 3,610 feet.

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

DISPERSION ANALYSIS

J-100 Balloons

Payload (Lbs.)	Free Lift (Grams)	No.Flights	Range	Standard Deviation
2	50	4	5036	2450
2	100	5	9320	4050
2	200	5	7090	3020
2	350	5	3652	1570
2	500	5	3631	1560
3	50	5	8366	3600
3	100	5	7369	3170
3	200	5	8622	3710
3	350	4	6772	3300
3	500	5	8385	3650
4	200	5	10905	4700
4	500	3	4877	2890
6	200	2	2733	2420
5.75	620	3	3314	1960
3 light clouds	200	2	400	358
3 heavy clouds	200	5	4786	2060
3 night flights	200	10	5850	1900
3 cloudy night	200	3	761	450
3 preheated	200	8	8238	2890
		Average	5582	2610

Average Range = 5,582 feet

Average Standard Deviation = 2,610 feet

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

DISPERSION ANALYSIS

J9-10-300 Balloons

Payload (Lbs.)	Free Lift (Grams)	No. Flights	Range	Standard Deviation
5	300	4	4033	1960
5	1000	4	12979	6300
10	300	4	10020	4860
10	700	4	2352	1140
10	1000	4	7736	3750
		Average	7400	3610

Average Range = 7,400 feet

Average Standard Deviation = 3,610 feet

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

References:

1.) E. Habib, DA36-039-SC-82. Dewey & Almy Chemical Co.

2.) Dewey & Almy Chemical Co., DA36-039-SC-15463, M. Burgess.

3.) W. H. Lewis, L. Squires, G. Broughton "Industrial chemistry of colloidal and amorphous materials" Macmillian, New York (1949).

4.) H. T. Mastenbrook, "Neoprene Carrier Balloons" Naval Research Laboratory, 17 Jan. 1951.

5.) Othmer and Frohlick, "Correlating permeability constants of gases through plastic membranes", Polotechnic Institute, Brooklyn, New York

6.) Sager and Sucher, "Permeability of Neoprene to Gases", Nat'l Bureau of Standards, Vol. 22, Jan. 1939.

7.) Barford at als "High-Altitude Free Balloon Flying", Imperial College of Science and Technology," London. 6-12-54.

8.) H. Landers, M. Stipple "Local Rate of Ascent of the Thirty Gram Balloon", A D No. 72988 Astia.

9.) F. W. Billmeyer, Jr., Textbook of "Polymer Chemistry", University of Delaware and Polychemical Department, E. I. DuPont de Nemours & Co., Inc.

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

CHART A. TASK II FLIGHT TEST DATA (AVERAGES) J-100 BALLOONS

ASCENSIONAL RATE CHARACTERISTICS (FT./MIN.)

	Payload (lbs)	Free-lift (Grams)	Average Altitude	Average Asc. Rate	From Gnd to 5000	5-10,000	10-15,000	15-20,000	20-25,000	25-30,000	30-35,000	35-40,000	40-45,000	Total Flight Time (minutes)
Daytime Clear Skies	2	50	49,530	260	198	220	223	251	268	389	322	341	349	167.0
	2	100	38,885	342	348	291	303	337	353	377	377	381	—	113.5
	2	200	47,636	441	457	403	391	426	427	452	453	497	503	98.0
	2	350	51,151	550	593	575	451	535	571	543	597	574	625	75.0
	2	500	35,618	643	874	649	611	618	581	667	636	633	—	61.0
	3	50	33,611	227	187	201	201	226	241	282	314	—		149.0
	3	100	36,455	317	269	280	292	301	326	356	378	364		115.0
	3	200	35,312	411	411	342	374	395	408	418	461	439		88.3
	3	350	35,285	527	610	474	479	502	516	536	554	538		67.8
	3	500	34,730	635	778	633	581	614	610	688	627	—		54.9
	4	200	30,776	400	469	388	365	350	387	403	444	—		77.7
	4	350	33,050	550	684	511	550	587	518	500	575	—		61.0
	4	500	28,900	548	699	575	531	538	542	540	—	—		64.2
	6	200	23,741	375	413	418	317	370	357	—	—	—		63.9
	5.75	680	23,000	651	798	728	567	585	654	—	—	—		35.4
Daytime-light clouds	3	200	36,004	412	370	355	387	390	393	437	500	527		87.0
Daytime-heavy clouds	3	200	38,730	429	454	382	393	419	435	437	457	478		90.3
Night-clear Skies	3	200	36,563	325	363	317	311	325	315	326	323	341		110.7
Night-heavy clouds	3	200	24,013	349	366	345	359	407	301	338	289	—		98.0
Daytime-clear weather Aged Balloons														
Age / Pre-heat														
24 months / None	3	200	26,870	398	397	394	385	408	457	—	—			58.4
24 months / 5 min.@200°F	3	200	31,277	416	466	378	381	429	422	431	485			75.0
19-20 months / none	3	200	31,307	403	434	379	365	402	351	436	457			75.0
13-15 months / none	3	200	32,510	389	460	356	352	378	391	420	418			83.5
3 months / 5 min.@200°F	3	200	34,105	409	489	384	375	385	417	443	439			83.6

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

CHART A (cont.) TASK II FLIGHT TEST DATA (AVERAGES) 29-10-300 BALLOONS CLEAR WEATHER DAYTIME

ASCENSIONAL RATE CHARACTERISTICS (FT./MIN.)

Pay Load (lbs)	Free Lift (grams)	Average Altitude (ft)	Average As. rate (Ft./min.)	500 to 5,000	5-10,000	10-15,000	15-20,000	20-25,000	25-30,000	30-35,000	35-40,000	40-45,000	45-50,000	50-55,000	55-60,000	Total Flight Time (min.)
5	300	58,187	513	547	506	482	478	470	476	492	600	540	540	605	657	114.6
5	1000	57,565	805	956	976	881	874	786	735	775	793	755	797	814	825	70.6
10	300	45,392	607	750	653	510	461	477	450	480	607	469	505	—	—	90.0
10	700	46,212	680	995	1008	829	632	534	598	602	559	642	665	—	—	68.0
10	1000	46,220	862	1110	1232	1116	1033	843	759	697	717	732	684	—	—	54.2

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

TASK II PHASE I CLEAR WEATHER DAY FLIGHTS J-100 BALLOONS

Ascension No.	#91	#94	#112	#116	Average of 4 flights	#79	#80	#81	#83	#85	Average 5 flights
Payload (lbs)	2	2	2	2		2	2	2	2	2	
Free Lift (grams)	50	50	50	50		100	100	100	100	100	
Gross Lift (grams)	1080	1080	1080	1080		1130	1130	1130	1130	1130	
Date	8-1-57	8-2-57	8-8-57	8-9-57		7-26-57	7-26-57	7-26-57	7-29-57	7-29-57	
Start	8:30 AM	9:30 AM	9:18 AM	9:30 AM		10:41 AM	1:05 PM	3:40 PM	11:35 AM	2:45 PM	
Finish	11:04 AM	12:00 AM	11:50 AM	12:17 PM		12:28 PM	3:07 PM	5:30 PM	1:17 PM	4:45 PM	
Time in Flight (minutes)	154.1	149.5	152.4	166.9	157	108	121.6	110.4	102.4	120	113.5
T2/T1 (°K)	220/256.8	238.5/301	215.5/258	215.5/252		230.6/255	228.5/300.5	230.3/300.5	238.4/305.5	211/312	
P1/P2 (millibars)	1115/226	1005/233	1011/162	1011/177		1008/238	1007/188	1011/248	1010/247	1005/162	
Burst Altitude (ft.)	38,734	38,457	43,533	42,586	40,830	36,365	41,476	35,499	36,004	44,760	38,868
Average Rate of Rise (ft./min.)	251	258	276	257	260	337	342	322	336	373	342
Burst Diameter (in.)	73.5	73.6	78.5	77.5	75.6	73.6	78.4	72.1	72.3	80.7	75.3
Burst Volume (cubic feet)	121	118	147	143	132	118	148	114	115.5	160	131
Rate of Rise (ft./min.)											
SFC to 5,000	184	180	225	182	198	318	326	373	279	448	348
5,000 10,000	208	231	227	213	220	294	257	286	255	314	298
10,000 15,000	226	227	223	217	223	324	257	280	303	318	303
15,000 20,000	238	256	258	254	251	333	331	326	344	355	337
20,000 25,000	257	267	286	262	268	318	326	301	340	378	333
25,000 30,000	278	312	289	279	289	370	381	341	384	396	377
30,000 35,000	328	314	342	303	322	381	373	342	405	385	377
35,000 40,000	366	370	355	373	366	281	394	367	417	388	391
40,000 45,000			366	332	349		410			396	
Minutes in Flight											
SFC to 5,000	20.3	26.6	21.3	25.6	24.2	15.1	14.7	12.8	17.2	10.7	13.8
5,000 10,000	24.0	21.6	22.0	23.5	22.7	17.0	16.8	17.5	16.7	15.9	16.8
10,000 15,000	22.0	22.0	22.5	23.0	22.5	15.4	16.8	17.8	16.5	16.0	16.5
15,000 20,000	21.0	19.5	19.4	19.7	19.9	15.0	15.1	15.3	14.5	14.1	14.8
20,000 25,000	19.4	18.7	17.5	19.1	18.7	15.7	15.4	16.6	14.7	13.2	15.0
25,000 30,000	18.0	16.0	17.3	17.9	17.3	13.3	13.1	14.4	13.0	12.6	13.3
30,000 35,000	15.2	15.9	14.6	16.5	15.5	13.1	13.4	14.6	12.4	13.0	13.3
35,000 40,000	10.2	9.4	14.1	13.4	13.6	8.5	12.7	1.2	2.4	12.9	9.7
40,000 45,000			9.7	8.9	2.47		3.6			12.0	

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

TASK II PHASE I CLEAR WEATHER DAY FLIGHTS J-100 BALLOONS

Ascension No.	#13	#78	#75	#77	#76		Average of 5 flights	#56	#57	#72	#70	#71		5 Flights Average
Payload (lbs.)	2	2	2	2	2			2	2	2	2	2		
Free lift (grams)	200	200	200	200	200			350	350	350	350	350		
Gross lift (grams)	1230	1230	1230	1230	1230			1380	1380	1380	1380	1380		
Date	7-18-57	7-26-57	7-25-57	7-25-57	7-25-57			7-22-57	7-22-57	7-23-57	7-23-57	7-23-57		
Start	11:00 AM	8:30 AM	11:25 AM	3:30 PM	1:30 PM			2:15 PM	4:00 PM	3:45 PM	11:45 AM	2:15 PM		
Finish	12:27 PM	10:08 AM	12:56 PM	5:09 PM	2:59 PM			3:33 PM	5:12 PM	5:02 PM	1:01 PM	3:26 PM		
Time in flight (minutes)	87	98.0	91	99	99		93	78.8	72	77	76	71.2		75
T_2 / T_1 (°K) P_1 / P_2 (millibars)	221/301 1013/225	220.4/281 1013/157	228.4/285.2 1014/202	221.6/265 999/163	228.8/312 1015/203			213/288 1013/167	220/302 1014/200	220.3/288.5 1014/200	220.8/287 1014/183	218.8/301.5 1014/205		
Burst Altitude (ft.)	37,752	45,387	40,092	44,882	40,020		40,626	43,671	38,819	40,321	42,316	38,823		41,181
Average Rate of Rise (ft./min.)	434	417	452	453	449		441	658	553	525	556	501		550
Burst diameter (in.)	76.7	79.7	79.3	84.3	79.3		79.6	87.3	82.5	87.5	85.0	81.8		83.8
Burst volume (cubic feet)	131	155	153	182	152		154.6	201	170	170	187	168		179
Rate of rise (ft./min.)														
SFC to 5,000	490	262	486	582	466		457	536	656	521	614	631		553
5,000 10,000	427	352	403	417	417		403	557	539	490	527	510		525
10,000 15,000	391	400	403	381	417		398	517	510	477	476	510		498
15,000 20,000	400	423	424	438	417		420	517	544	533	558	544		535
20,000 25,000	454	423	424	403	431		427	556	531	477	572	570		521
25,000 30,000	417	428	472	454	490		452	563	485	556	582	520		543
30,000 35,000	442	417	472	481	455		453	582	574	589	582	658		597
35,000 40,000	490	472	481	490	545		497	575	587	544	558	604		574
40,000 45,000	—	—	—	513	—		513	628	—	—	625	—		625
Minutes in Flight														
SFC to 5,000	10.2	13.2	11.0	9.0	10.2		10.5	9.0	7.3	9.2	7.8	7.6		8.1
5,000 10,000	11.7	14.2	12.4	12.4	12.0		12.6	9.0	9.3	10.2	9.5	9.8		9.5
10,000 15,000	12.8	12.5	12.4	13.6	12.4		12.6	9.7	9.8	10.5	10.5	9.8		10.0
15,000 20,000	12.5	11.8	11.8	11.5	12.4		11.9	9.7	9.2	9.4	9.3	9.2		9.3
20,000 25,000	11.0	11.8	11.8	13.3	11.6		11.7	9.2	9.4	10.5	9.6	9.6		9.6
25,000 30,000	12.0	11.7	10.6	11.5	10.2		11.1	8.4	10.1	9.0	8.6	9.6		9.2
30,000 35,000	11.3	12.8	10.6	9.9	11.0		11.0	8.6	8.7	8.5	8.6	7.6		8.4
35,000 40,000	8.7	10.6	10.4	10.6	9.2		11.1	8.7	8.2	9.2	8.8	8.0		8.7
40,000 45,000	—	—	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	—	[illegible]	—		[illegible]

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

TASK II   PHASE I   CLEAR WEATHER DAY FLIGHTS J-100 BALLOONS

Ascension No.	#49	#50	#51	#52	#53		Average of 5 flights
Payload (lbs.)	2	2	2	2	2		
Free lift (grams)	500	500	500	500	600		
Gross lift (grams)	1530	1530	1530	1530	1530		
Date	7-12-57	7-16-57	7-16-57	7-16-57	7-22-57		
Start	10:30AM	1:00PM	3:45PM	5:00PM	12:30PM		
Finish	11:29AM	2:03PM	4:49PM	6:01PM	1:27PM		
Time in Flight (minutes)	57.8	63.7	64	61	57		61
T_2 / T_1 (°K)	210/307	220/303	218/301	223/300	223.5/301		
P_1 / P_2 (millibars)	1007/207	1007/157	1008/200	1013/233	1118/225		
Burst Altitude (ft.)	39,403	49,882	44,052	37,251	37,503		39,018
ave. Rate of Rise (ft/min)	683	649	627	611	655		643
Burst Diameter (in.)	83	85	84.5	80.6	81.5		82.9
Burst Volume (cubic feet)	175	186	181	161	166		174
Rate of Rise (ft./min.)							
SFC to 5,000	1060	704	855	751	802		824
5,000 10,000	806	588	625	610	617		649
10,000 15,000	617	581	582	625	588		606
15,000 20,000	724	603	641	574	625		618
20,000 25,000	532	597	555	562	610		580
25,000 30,000	677	689	625	610	715		647
30,000 35,000	626	694	595	610	675		635
35,000 40,000	622	699	610	592	642		633
40,000 45,000		629					
Minutes in Flight							
SFC to 5,000	4.8	6.8	6.0	6.3	6.1		5.8
5,000 10,000	6.2	8.5	8.0	8.2	8.1		7.7
10,000 15,000	8.1	8.6	8.8	8.0	8.5		8.3
15,000 20,000	6.9	8.3	7.8	8.7	8.0		8.1
20,000 25,000	9.4	8.4	9.1	8.9	8.2		8.6
25,000 30,000	7.4	7.3	8.0	8.2	7.0		7.7
30,000 35,000	8.0	7.2	8.4	8.2	7.4		7.9
35,000 40,000	7.1	7.2	8.2	3.8	3.9		6.3
40,000 45,000		1.4					

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

TASK II PHASE I CLEAR WEATHER DAY FLIGHTS J-100 BALLOONS

Ascension No.	#38	#37	#34	#39	#42		Average 5 flights	#1	#28	#31	#40	#42		Average 5 flights
Payload (lbs.)	3	3	3	3	3			3	3	3	3	3		
Free Lift (grams)	50	50	50	50	50			100	100	100	100	100		
Gross Lift (grams)	1535	1535	1525	1535	1535			1585	1585	1585	1585	1585		
Date	7-11-57	7-8-57	7-22-57	7-23-57	7-18-57			6-19-57	6-28-57	7-8-57	7-19-57	7-19-57		
Start	8:45 AM	12:40 PM	8:30 AM	8:15 AM	8:22 AM			8:20 AM	8:25 AM	9:00 AM	10:45 AM	1:15 PM		
Finish	11:25 AM	3:00 PM	10:54 AM	10:50 AM	11:07 AM			10:20 AM	10:33 AM	10:57 AM	12:52 PM	3:09 PM		
Time in Flight (ft./mins.)	160.4	160	144	155	145		148.9	109.7	128	110.6	107	114		115
T_2 / T_1 (°K)	288.5/280	274/243	289.4/288	278/286	284/293			287/299	286.5/293	288/280	288.8/251.0	288.7/298		
P_1 / P_2 (millibars)	1015/375	1018/222	1015/250	1016/282	1013/277			1010/208	980/151	1005/248	1006/254	1015/241		
Burst Altitude (ft.)	28,908	38,294	31,778	35,200	33,103		33,666	34,173	41,632	35,880	34,878	36,007		36,455
ave. Rate of Rise (ft/min)	167	273	220	227	231		227	312	354	308	326	317		317
Burst Diameter (in.)	73.0	82.4	75.5	79.0	76.0		77.4	79	87	82.6	79.5	80.6		81.3
Burst Volume (cubic feet)	122	171	132	151	136		143	150	205	159	153	160		161
Rate of Rise (ft./min.)														
SFC to 5,000	163	259	188	184	178		187	274	271	258	337	303		289
5,000 10,000	166	225	218	203	197		201	295	269	264	291	279		260
10,000 15,000	167	245	197	215	218		208	299	301	283	299	280		292
15,000 20,000	172	245	227	221	221		220	289	309	313	309	312		306
20,000 25,000	221	276	236	243	256		241	336	314	331	340	309		326
25,000 30,000	286	323	298	248	255		282	355	379	358	340	370		357
30,000 35,000		333	327	247	255		314	339	394	378	371	371		370
35,000 40,000		438							373	380		354		364
40,000 45,000									369					
Minutes in Flight														
SFC to 5,000	29.3	18.5	30.2	26.0	28.0		28.7	17.5	17.7	16.6	14.2	15.0		16.6
5,000 10,000	30.2	22.2	23.0	24.0	26.4		29.9	16.9	18.6	18.9	17.2	17.9		17.9
10,000 15,000	26.0	20.4	25.4	22.2	22.9		24.0	16.7	16.6	17.7	16.7	17.8		17.1
15,000 20,000	29.0	20.4	22.0	22.6	21.2		22.7	17.3	16.7	16.0	16.2	16.0		16.3
20,000 25,000	22.6	18.1	21.8	20.0	19.5		20.5	14.5	15.9	15.1	14.7	16.2		15.3
25,000 30,000	19.5	15.5	16.0	20.0	17.0		17.7	14.1	18.2	19.8	14.7	13.5		14.0
30,000 35,000		15.0	5.4	12.0	10.7		11.7	12.3	12.7	18.2	18.9	13.5		13.5
35,000 40,000		9.7							13.5	2.3		3.0		4.1
40,000 45,000									3.7					

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

TASK II PHASE I CLEAR WEATHER DAY FLIGHTS J-100 BALLOONS

Ascension No.	#6	#16	#17	#10	#11		Average of 5 flights	#15	#21	#23	#31		Average of 4 flights
Payload (lbs.)	3	3	3	3	3			3	3	3	3		
Free lift (grams)	200	200	200	200	200			350	350	350	350		
Gross lift (grams)	1085	1085	1015	1085	1085			1835	1835	1835	1825		
Date	6-27-57	7-15-57	7-15-57	9-19-57	9-19-57			6-21-57	6-25-57	6-27-57	7-9-57		
Start	11:00 AM	2:00 PM	3:55 PM	8:55 AM	10:55 AM			12:00 PM	11:00 AM	9:10 AM	10:00 AM		
Finish	12:15 PM	3:35 PM	5:29 PM	10:31 AM	12:21 PM			1:11 PM	12:06 PM	11:16 AM	11:58 AM		
Time in Flight (minutes)	74.3	95.5	94	96.6	76		88.3	71	66	76	58.4		67.8
T_2 / T_1 (°K)	228.5/306.2	224.8/304.5	231/317	207.7/285.8	235.6/283			232/300	238.9/301	237/298	236.8/305		
F_1 / F_2 (milliliters)	855/307	1005/220	1005/212	1010/240	1010/268			1005/235	1005/274	855/225	1055/300		
Burst Altitude (ft.)	31,361	38,601	38,288	36,165	30,676		35,312	37,555	33,517	38,359	31,627		35,285
Ave. Rate of Rise (ft/min)	423	405	389	374	415		401	545	518	510	542		527
Burst Diameter (in.)	78.2	84.7	85.0	83.2	77.2		81.6	86.5	81.9	87.2	80.0		83.9
Burst Volume (cubic feet)	146	186	152	174	140		167.6	197.5	168	202	157		181
Rate of Rise (ft./min.)													
SFC to 5,000	371	420	427	368	408		411	758	504	479	705		610
5,000 10,000	391	363	352	340	362		367	521	496	459	421		479
10,000 15,000	442	378	351	327	368		374	462	480	490	515		479
15,000 20,000	435	368	412	368	391		388	455	600	485	556		502
20,000 25,000	417	417	403	373	410		408	490	606	510	556		516
25,000 30,000	455	402	396	420	418		418	575	550	543	476		536
30,000 35,000	486	464	430	410	417		441	550	585	537	542		554
35,000 40,000		457	384	466			438	518		557	/		538
40,000 45,000													
Minutes in Flight													
SFC to 5,000	12.9	11.4	11.8	13.0	11.2		11.7	6.4	9.5	10.0	6.8		7.9
5,000 10,000	12.8	13.8	14.2	14.7	13.8		13.8	9.6	10.1	10.9	10.4		10.5
10,000 15,000	11.3	13.2	14.0	15.3	13.6		13.4	10.8	10.1	10.2	9.7		10.4
15,000 20,000	11.5	13.6	12.1	13.6	12.8		12.7	11.0	10.0	10.1	9.0		10.0
20,000 25,000	12.0	12.0	12.4	13.4	11.6		12.2	10.2	9.9	9.8	9.0		9.7
25,000 30,000	11.0	12.4	12.6	11.9	12.0		12.0	8.7	9.1	9.2	10.5		9.3
30,000 35,000	9.8	10.8	11.6	12.2	2.1		11.3	9.1	6.0	9.3	3.0		9.0
35,000 40,000		8.0	11.2	8.5			.7	6.0		6.1			.5
40,000 45,000													

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

TASK II   PHASE I   CLEAR WEATHER DAY FLIGHTS   J-100 BALLOONS

Ascension No.	#5	#12	#14	#18	#33		Average of 5 flights						
Payload (lbs.)	3	3	3	3	3								
Free Lift (grams)	500	500	500	600	500								
Gross Lift (grams)	1985	1985	1985	1965	1985								
Date	6-19-57	6-20-57	6-21-57	6-24-57	7-8-57								
Start	8:00 PM	7:18 PM	10:13 AM	10:16 AM	3:32 PM								
Finish	8:57 PM	8:11 PM	10:59 AM	11:18 AM	4:37 PM								
Time in flight (minutes)	57.3	53.3	46	63	65		56.9						
T_2 / T_1 (°K)	216/303	288/306	255/298	233/304	224/308								
P_1 / P_2 (millibars)	1016/215	1015/267	1013/316	1010/302	1010/285								
Burst Altitude (ft.)	38,889	34,626	30,688	31,690	37,918		34,786						
Ave. Rate of Rise(ft/min)	680	650	660	598	585		635						
Burst Diameter (in.)	89.3	85.5	81.3	82.1	89.0		85.4						
Burst Volume (cubic feet)	217	190	164	170	215		191						
Rate of Rise (ft./min.)													
SFC to 5,000	920	825	760	613	760		775						
5,000 10,000	806	610	613	617	527		633						
10,000 15,000	582	626	617	562	516		581						
15,000 20,000	588	626	657	568	582		604						
20,000 25,000	603	626	642	594	533		600						
25,000 30,000	668	633	635	603	588		625						
30,000 35,000	676	626	629	622	518		627						
35,000 40,000	681				632								
40,000 45,000													
Minutes in Flight													
SFC to 5,000	5.7	5.8	6.3	7.8	6.3		6.2						
5,000 10,000	6.2	8.2	8.3	8.1	9.5		7.9						
10,000 15,000	8.6	8.6	8.1	8.9	9.7		8.6						
15,000 20,000	8.5	8.0	7.6	8.8	8.6		8.3						
20,000 25,000	8.3	8.0	7.8	8.4	9.4		8.3						
25,000 30,000	7.5	7.9	7.4	8.3	8.5		8.0						
30,000 35,000	7.4	7.4	.8	7.7	8.5		7.8						
35,000 40,000	5.7				4.6								
40,000 45,000													

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

TASK II PHASE I CLEAR WEATHER DAYTIME FLIGHTS J-300 BALLOONS

Ascension No.	#15	#19	#18	#14	#16	Average of 5 flights	#13	#17	#20	Average of 3 flights
Payload (lbs.)	4	4	4	4	4		4	4	4	
Free Lift (grams)	800	800	800	800	800		800	800	800	
Gross Lift (grams)	2138	2138	2138	2138	2138		2440	2440	2440	
Date	7-5-57	7-11-57	7-16-57	7-11-57	7-19-57		6-21-57	6-24-57	6-28-57	
Start	11:50 AM	10:45 AM	1:50 PM	3:55 PM	8:40 AM		8:34 AM	8:50 AM	8:50 AM	
Finish	1:05 PM	12:00 PM	3:00 PM	5:25 PM	9:56 AM		9:29 AM	9:40 AM	9:48 AM	
Time in Flight (minutes)	75	75	70	90	76	77.2	55	50	57.5	54.2
T_2 / T_1 (°K)	290/304	288/291	289/305	289/301	291/288		285/281	289/311	280/308	
P_1/ P_2 (millibars)	1011/280	1013/292	1011/387	1013/238	1017/331		1010/299	1011/375	1010/316	
Burst Altitude (ft.)	38,210	37,102	25,470	36,325	27,657	32,776	31,877	27,000	29,883	29,590
Ave. Rate of Rise (ft/min)	523	478	363	401	363	426	580	540	525	548
Burst Diameter (in.)	85.0	85.0	78.0	88.5	82.0	84.1	88.6	83.2	86.0	85.9
Burst Volume (cubic feet)	187	187	150	218	158	180	218	177	194	196
Rate of Rise (ft./min.)										
SFC to 5,000	527	478	301	557	300	449	675	564	587	555
5,000 10,000	394	415	301	483	340	388	549	500	526	525
10,000 15,000	381	385	301	237	365	305	588	510	510	530
15,000 20,000	394	438	367	387	345	250	532	502	521	528
20,000 25,000	427	455	362	347	361	387	550	538	544	542
25,000 30,000	447	455	211	393	488	403	550	527	538	540
30,000 35,000	469	447		470		464	625		549	
35,000 40,000				457						
40,000 45,000										
Minutes in Flight										
SFC to 5,000	9.1	11.3	18.0	8.6	18.0	10.7	7.1	8.5	8.6	8.0
5,000 10,000	12.7	12.1	15.6	11.1	14.5	13.2	9.1	10.0	9.5	9.5
10,000 15,000	13.1	13.0	18.9	14.6	13.7	13.7	8.5	9.8	9.8	9.3
15,000 20,000	12.7	11.4	18.5	12.9	14.6	18.8	9.4	8.9	9.6	9.3
20,000 25,000	11.8	11.0	14.0	14.4	13.6	12.9	9.1	9.4	9.2	9.2
25,000 30,000	11.2	11.0	1.4	12.7	0.3	12.4	9.0	3.8	9.3	9.1
30,000 35,000	4.9	4.9		11.9		1.7	3.4		1.5	
35,000 40,000				2.9						
40,000 45,000										

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

TASK II PHASE I CLEAR WEATHER DAYTIME FLIGHTS J-100 BALLOONS

Ascension No.	#36	#37		Average of 2 flights		#3	#23	#16		Average of 3 flights
Payload (lbs.)	6	6				5.75	5.75	5.75		
Free Lift (grams)	200	200				620	620	620		
Gross Lift (grams)	3047	3047				3380	3380	3380		
Date	7-9-57	7-9-57				6-21-57	6-28-57	6-21-57		
Start	1:45PM	3:30PM				10:01AM	2:00PM	2:00PM		
Finish	2:50PM	4:53PM				10:33AM	2:37PM	2:40PM		
Time in flight (minutes)	65	68.7		63.9		33.2	37.3	38.6		35.4
T_2 / T_1 (°K)	258/303	258/303				283/301	280/305	288/304		
P_1 / P_2 (millibars)	1016/425	1016/385		.		1015/428	1015/411	1015/444		
Burst Altitude (ft.)	22,375	25,108		23,741		21,782	25,166	22,169		23,010
ave. Rate of rise (ft/min)	350	400		375		657	674	683		651
Burst Diameter (in.)	85.6	88.0		86.8		88.0	91.6	88.4		89.3
Burst Volume (cubic feet)	193	210		202		210	233	212		218
Rate of Rise (ft./min.)										
SFC to 5,000	337	489		413		978	735	683		798
5,000 10,000	352	403		411		617	925	642		728
10,000 15,000	318	316		317		587	516	633		567
15,000 20,000	862	378		370		588	594	574		585
20,000 25,000	331	383		357		650	691	516		654
25,000 30,000										
30,000 35,000										
35,000 40,000										
40,000 45,000										
Minutes in Flight										
SFC to 5,000	14.2	9.8		11.6		4.9	6.5	7.0		6.4
5,000 10,000	14.1	11.8		12.3		8.1	5.4	7.8		6.9
10,000 15,000	15.7	15.8		15.8		9.8	9.8	7.9		8.8
15,000 20,000	13.6	13.7		13.8		8.5	8.4	8.7		8.5
20,000 25,000	7.2	13.1		10.5		7.5	7.2	4.2		6.6
25,000 30,000										
30,000 35,000										
35,000 40,000										
40,000 45,000										

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

TASK II PHASE 2 AVERAGE WEATHER DAY FLIGHTS J-100 BALLOONS

Ascension No.	28	14	Average of 2 flights	#1	#3	#9	#18	#19	Average of 5 Flights
	LIGHT CLOUD COVER			HEAVY CLOUD COVER					
Payload (lbs.)	3	3		3	3	3	3	3	
Free Lift (grams)	200	200		200	200	200	200	200	
Gross Lift (grams)	1085	1085		1085	1085	1085	1085	1085	
Date	8-22-57	9-24-57		8-22-57	9-4-57	9-18-57	10-7-57	10-7-57	
Start	2:20 PM	9:00 AM		11:50 AM	3:30 PM	1:30 PM	11:30 AM	1:45 PM	
Finish	3:45 PM	10:29 AM		1:23 PM	4:58 PM	3:03 PM	12:50 PM	3:15 PM	
Time in Flight (minutes)	85	89	87	93.4	88.3	93.2	80.7	90.0	90.3
T_2/T_1 (°K)	224/281	223.6/283		224.5/281	224.4/306.8	227/281	229/286.7	220/287	
P_1/P_2 (millibars)	1020/237	1017/238		1011/210	198/243	1017/169	1011/225	1013/217	
Burst Altitude	36,204	35,804	36,004	39,150	39,772	41,586	37,730	38,396	38,730
ave. Rate of Rise	425	398	412	420	416	446	435	427	429
Burst Diameter (in.)	83.0	83.0	83.0	87.1	83.2	88.4	84.0	85.0	85.5
Burst Volume (cubic feet)	174	174	174	200	177	210	178	186	190
Rate of Rise (ft./min.)									
SFC to 5,000	355	384	370	347	440	611	461	433	454
5,000 10,000	410	379	395	388	387	417	382	385	382
10,000 15,000	443	350	397	385	403	397	400	397	393
15,000 20,000	474	367	396	473	397	417	420	438	419
20,000 25,000	424	362	393	461	417	454	427	413	435
25,000 30,000	443	431	437	417	431	438	458	442	437
30,000 35,000	410	521	466	478	448	462	403	497	457
35,000 40,000	482	573	527	512	467	454	515	458	479
40,000 45,000						481			
Minutes in Flight									
SFC to 5,000	13.4	12.4	12.9	13.0	11.9	7.8	10.4	11.0	10.6
5,000 10,000	12.2	13.2	12.7	13.6	12.0	12.0	13.1	13.0	12.1
10,000 15,000	11.3	14.3	12.6	13.0	12.4	13.2	12.5	12.6	12.7
15,000 20,000	11.8	13.6	12.6	11.8	12.6	12.0	11.9	11.4	11.9
20,000 25,000	11.8	13.8	12.7	11.8	10.7	11.8	11.7	12.1	11.5
25,000 30,000	11.3	11.6	11.4	12.0	11.6	11.4	10.9	11.3	11.4
30,000 35,000	11.4	9.6	11.0	11.0	11.3	10.6	10.8	11.8	10.9
35,000 40,000	2.5	1.4	1.9	8.2	8.8	11.0	5.4	7.4	7.8
40,000 45,000						3.2			

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

TASK II PHASE 3 CLEAR WEATHER DAY FLIGHTS 2-100 AGED BALLOONS

Ascension No.	#8	#9	Average of 2 flights	#9	#9	Average of 2 flights	#15	#16	Average of 2 flights
Age of Balloon	24 mos.	24 mos.		24 mos.	24 mos.		19 mos.	20 mos.	
Payload (lbs.)	3	3		3	3		3	3	
Free Lift (grams)	200	200		200	200		200	200	
Gross Lift (grams)	1085	1085		1085	1085		1085	1085	
Pre-conditioning	NONE	NONE		5' @ 200°F	5' @ 200°F		NONE	NONE	
Date	7-29-57	6-1-57		8-1-57	8-2-57		9-5-57	9-6-57	
Start	10:00 AM	2:30 PM		12:40 PM	1:00 PM		10:59 AM	11:00 AM	
Finish	10:47 AM	3:27 PM		1:55 PM	2:15 PM		12:18 PM	12:21 PM	
Time in Flight (minutes)	47	57.7	52.4	75	75	75	75	81	78
T2 / T1 (°F)	200/395	282/300		250/300	248/303		238/293	228/289	
P1 / P2 (millibars)	1011/505	1011/435		1014/312	1014/305		1015/323	1008/270	
Burst Altitude	18,987	22,713	20,880	30,918	31,557	31,227	29,324	33,471	31,367
ave. Rate of Rise	402	394		412	420	416	395	412	403
Burst Diameter (in.)	68.0	70.4	69.2	77.0	78.0	77.5	76.2	80.0	78.1
Burst Volume (cubic feet)	97	107	102	139	145	142	135	155	145
Rate of Rise (ft./min.)									
SFC to 5,000	399	386	392	478	452	446	402	467	434
5,000 10,000	391	397	394	357	400	378	378	368	374
10,000 15,000	391	379	385	378	397	388	350	387	369
15,000 20,000	422	393	418	424	434	429	397	407	412
20,000 25,000		410	400	410	439	422	387	431	391
25,000 30,000				434	428	431	440	431	436
30,000 35,000				430	420	425		452	452
35,000 40,000									
40,000 45,000									
Minutes in Flight									
SFC to 5,000	12.0	12.4	12.2	10.0	11.9	10.7	10.3	11.7	11.0
5,000 10,000	12.8	12.6	12.7	14.0	12.5	13.2	13.2	13.6	13.4
10,000 15,000	12.8	13.2	13.0	13.2	12.6	12.9	14.3	12.9	13.6
15,000 20,000	9.3	12.7	12.4	11.8	11.5	11.7	12.6	12.3	12.4
20,000 25,000		6.6	2.1	12.2	11.5	11.8	14.9	11.6	12.8
25,000 30,000				11.5	11.7	11.6	9.8	11.6	11.5
30,000 35,000				2.1	2.7	2.9		7.8	3.0
35,000 40,000									
40,000 45,000									

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

TASK II PHASE 3 CLEAR WEATHER DAY FLIGHTS J-300 GRAM BALLOONS

Ascension No.	#13	#7	#8	#12	#15	#23	#21	#19	Average of 8 Flights
Age of Balloon	15 mos	13 mos	13 mos	14 mos	14 mos	15 mos	15 mos	15 mos	
Payload (lbs.)	3	3	3	3	3	3	3	3	
Free Lift (grams)	200	200	200	200	200	200	200	200	
Gross Lift (grams)	1085	1085	1085	1085	1085	1085	1085	1085	
Pre-conditioning	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	
Date	9-5-57	9-6-57	9-6-57	9-20-57	9-25-57	8-12-57	8-13-57	8-12-57	
Start	9:20 AM	11:00 AM	3:00 PM	9:00 AM	9:00 AM	3:45 PM	8:30 AM	9:10 AM	
Finish	10:43 AM	12:20 PM	4:06 PM	10:19 AM	10:25 AM	5:23 PM	10:01 AM	10:36 AM	
Time in Flight (minutes)	73	80	66	79	85	98	91	86	83.5
T_2/T_1 (°K)	244/282	227/282	244/287	230/287	223/285	219/303	230/281	225/283	
P_1/P_2 (millibars)	1004/350	1008/207	1018/381	1011/283	1011/285	1011/181	1017/282	1008/237	
Burst Altitude (ft.)	27,454	33,580	25,818	32,017	31,185	40,050	33,018	36,755	32,518
Ave. Rate of Rise (ft/min)	376	417	391	408	366	413	362	382	385
Burst Diameter (in.)	75.4	80.0	72.5	78.5	77.6	87.2	78.6	83.2	79.3
Burst Volume (cubic Feet)	128	151	117	148	143	204	154	175	153
Rate of Rise (ft./min.)									
SFC to 5,000	584	518	553	406	343	480	337	371	450
5,000 10,000	301	343	367	390	351	362	347	352	356
10,000 15,000	349	397	329	357	349	305	325	347	352
15,000 20,000	359	411	362	385	365	397	368	376	371
20,000 25,000	387	411	410	385	367	413	368	390	390
25,000 30,000	393	415		475	362	443	385	400	420
30,000 35,000		475		433	379	474	435	410	418
35,000 40,000						432		460	
40,000 45,000									
Minutes in Flight									
SFC to 5,000	8.6	9.2	9.0	10.3	14.0	10.0	14.2	12.9	10.6
5,000 10,000	16.6	14.6	13.8	12.8	12.8	13.8	14.4	14.2	14.0
10,000 15,000	14.3	12.6	15.2	14.0	14.3	13.7	15.4	14.4	14.2
15,000 20,000	13.9	12.2	13.8	13.0	13.7	12.6	13.6	13.3	13.2
20,000 25,000	12.9	12.5	13.5	13.0	13.6	12.1	13.6	12.8	12.8
25,000 30,000	6.3	10.3		10.5	13.8	11.3	13.0	12.5	11.9
30,000 35,000		8.3		4.8	3.0	11.8	6.9	12.2	6.0
35,000 40,000						13.1		3.8	
40,000 45,000									

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

TASK II PHASE I CLEAR WEATHER NIGHT FLIGHTS J-100 BALLOONS

Ascension No.	#118	#101	#102	#103	#106	#107	#108	#110	#112	#115		Average of 10 Flights
Payload (lbs)	3	3	3	3	3	3	3	3	3	3		
Free Lift (grams)	200	200	200	200	200	200	200	200	200	200		
Gross Lift (grams)	1085	1085	1085	1085	1085	1085	1085	1085	1085	1085		
Date	7-15-57	8-5-57	8-6-57	8-6-57	8-7-57	8-7-57	8-8-57	8-8-57	8-8-57	8-9-57		
Start	11:00 PM	9:00 PM	9:30 PM	11:45 PM	2:13 AM	4:25 AM	1:00 AM	3:20 AM	10:40 PM	1:00 AM		
Finish	1:07 AM	10:48 PM	11:14 PM	1:32 AM	4:02 AM	6:17 AM	2:51 AM	5:08 AM	12:26 AM	2:52 AM		
Time in Flight (minutes)	127	108	104	107	119	112	111	108	106	112		110.7
T_2 / T_1 (°K)	288/302	282/292	275/299	273/291	275/287	275/287	281/291	283/291	287/291	284/291		
P_1 / P_2 (millibars)	1015/224	1015/207	1017/244	1017/230	1017/255	1017/255	1011/228	1011/238	1018/250	1018/243		
Burst Altitude	38,004	32,214	36,197	37,113	34,655	34,466	37,755	36,854	35,814	36,414		35,903
Avg. Rate of Rise (ft/min)	299	315	346	347	291	308	341	338	344	325		325
Burst Diameter (in.)	85.0	78.6	87.8	83.6	81.0	81.0	83.6	88.5	81.6	82.5		82.1
Burst Volume (cubic feet)	188	149	170	179	162	162	179	172	167	172		170
Rate of Rise (ft./min.)												
SFC to 5,000	328	353	417	359	298	275	402	387	386	341		363
5,000 10,000	278	333	387	355	278	305	327	336	331	305		317
10,000 15,000	286	319	316	326	312	318	294	319	329	312		310
15,000 20,000	294	325	338	307	315	294	345	313	338	324		325
20,000 25,000	294	279	354	324	296	301	331	317	334	302		313
25,000 30,000	316	307	320	307	279	308	335	370	345	305		328
30,000 35,000	278	303	307	312	382	301	351	350	345	350		323
35,000 40,000	320		358	300			350	338	304	302		341
40,000 45,000												
Minutes in Flight												
SFC to 5,000	14.4	15.6	12.8	12.0	16.1	14.8	11.9	12.9	12.4	13.8		13.8
5,000 10,000	18.0	15.0	15.3	14.0	17.9	16.5	15.3	14.9	15.1	16.4		15.8
10,000 15,000	17.5	16.2	15.8	15.6	16.0	16.0	17.0	16.2	15.2	16.0		16.1
15,000 20,000	17.0	15.4	14.8	13.6	16.4	16.9	14.5	16.1	14.8	15.2		15.4
20,000 25,000	17.0	18.3	14.1	15.4	16.9	16.6	15.1	15.8	15.0	16.6		16.0
25,000 30,000	15.8	16.3	15.6	13.6	17.9	16.2	14.9	13.3	14.5	16.4		15.3
30,000 35,000	18.4	7.3	13.6	16.6	17.7	14.9	14.2	14.3	14.5	14.3		15.5
35,000 40,000	9.6		5.4	7.0			8.0	5.5	2.2	3.9		7.8
40,000 45,000												

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

TASK II PHASE I SOLID CLOUD COVER HIGH FLIGHTS J-300 BALLOONS

Accession No.	#20B	#23B	#21B		Average of 3 Flights
Payload (lbs.)	3	3	3		
Free Lift (grams)	800	800	800		
Gross Lift (grams)	1085	1085	1085		
Date	11-8-57	11-20-57	11-21-57		
Start	9:30 AM	9:15 AM	9:00 AM		
Finish	11:07 AM	10:45 AM	10:37 AM		
Time in Flight (minutes)	107	90	97		98
T_2 / T_1 (°K)	223/287	216/281	222/284		
P_1 / P_2 (millibars)	1009/273	1010/244	1013/260		
Burst Altitude (ft.)	38,953	34,476	36611		36,013
avg. Rate of Rise (ft/min)	308	383	357		349
Burst Diameter (in.)	79.3	81.0	81.3		80.5
Burst Volume (cubic feet)	152	162	164		159
Rate of Rise (ft./min.)					
SFC to 5,000	386	398	344		376
5,000 10,000	282	390	364		345
10,000 15,000	333	427	319		359
15,000 20,000	354	454	413		407
20,000 25,000	348	345	390		361
25,000 30,000	238	368	413		338
30,000 35,000	284	304	281		289
35,000 40,000					
40,000 45,000					
Time in Flight (min.)					
SFC to 5,000	12.5	11.9	12.8		13.1
5,000 10,000	17.7	12.8	13.7		14.6
10,000 15,000	15.0	11.7	15.7		14.9
15,000 20,000	14.1	11.0	12.1		12.5
20,000 25,000	14.8	14.5	12.8		13.9
25,000 30,000	21.0	13.8	12.1		14.8
30,000 35,000	10.4	14.7	16.5		13.9
35,000 40,000					
40,000 45,000					

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

TASK II PHASE 5. CLEAR WEATHER DAY FLIGHTS J9-10-300 BALLOONS

Ascension No.	#89	#97	#103	#110		Average of 4 Flights		#14	#16	#73	#88		Average of 4 Flights
Payload (lbs.)	5	5	5	5				5	5	5	5		
Free Lift (grams)	800	800	800	800				1000	1000	1000	1000		
Gross Lift (grams)	2970	2980	2980	2980				3680	3620	3620	3620		
Date	7-30-57	8-2-57	8-7-57	8-5-57				7-11-57	7-22-57	7-25-57	7-30-57		
Start	1:30 PM	9:00 AM	6:55 AM	1:10 PM				5:38 AM	6:00 PM	6:30 AM	11:40 AM		
Finish	3:09 PM	10:49 AM	9:09 AM	3:03 PM				4:38 PM	7:18 PM	9:33 AM	12:48 PM		
Time in Flight (minutes)	99.7	109	137.6	113		114.5		60	78	63	68		70
T_2 / T_1 (°K)	211/288	263/300	218/288	213/288				218/305	211/288	213/282	211/288		
P_1 / P_2 (millibars)	1008/65	1018/57	1011/78	1012/78				1010/80	1012/168	1017/115	1017/80		
Burst Altitude (feet)	56,888	55,185	58,610	55,610		56,187		54,848	64,381	51,848	56,788		57,665
Average Rate of Rise (ft/min)	584	507	483	626		613		815	887	744	834		808
Burst Diameter (ft)	11.4	10.68	11.8	11.6		11.47		12.25	13.75	11.0	12.4		12.25
Burst Volume (cubic feet)	786	614	820	820		803		974	1370	708	980		993
Ascent Rate from:													
SFC to 5,000	685	620	367	695		542		1005	1181	788	941		986
5,000 10,000	685	353	340	618		508		1186	1150	794	634		976
10,000 15,000	676	470	367	485		488		1110	1020	658	725		881
15,000 20,000	568	454	423	448		478		1011	901	658	875		874
20,000 25,000	580	485	417	500		470		1008	793	785	880		786
25,000 30,000	498	676	413	490		471		746	715	666	784		738
30,000 35,000	568	476	483	505		497		834	781	775	700		775
35,000 40,000	515	549	459	485		511		820	766	785	884		793
40,000 45,000	556	574	611	580		541		715	736	870	766		755
45,000 50,000	508	580	490	550		541		808	695	780	849		797
50,000 55,000	610	714	520	508		615		866	793	750	864		814
55,000 65,000	769	615	680	635		667		814	781 770		879		825
Minutes in Flight From:													
SFC to 5,000	7.6	9.8	18.1	6.9		8.6		4.5	4.8	6.1	5.1		4.8
5,000 10,000	7.3	18.7	14.7	8.8		9.6		4.6	4.8	6.3	6.0		5.1
10,000 15,000	7.4	10.6	14.4	11.5		10.4		4.5	4.9	7.6	6.8		5.7
15,000 20,000	8.8	11.6	11.6	11.3		10.6		5.6	5.8	7.6	5.7		5.7
20,000 25,000	11.6	10.3	18.8	11.4		10.5		6.8	6.4	6.9	6.1		6.4
25,000 30,000	10.1	9.7	18.4	10.8		10.5		6.7	7.0	7.3	6.3		6.8
30,000 35,000	8.9	10.5	11.8	9.8		10.8		6.6	6.4	6.9	6.6		6.5
35,000 40,000	9.7	9.8	11.0	10.3		10.0		6.1	6.7	6.9	5.6		6.3
40,000 45,000	9.6	8.7	9.6	9.6		9.5		7.1	6.6	6.1	6.6		6.6
45,000 50,000	8.8	9.1	10.8	9.1		9.3		5.8	7.8	6.4	5.9		6.3
50,000 55,000	8.7	7.0	9.4	8.4		8.8		6.8	6.3	8.7	6.8		6.1
55,000 60,000 60,000 65,000	4.8	6.8	7.5	7.8		4.9		8.8	6.4 5.6		8.6		8.1

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

TASK II PHASE 5 CLEAR WEATHER DAY FLIGHTS J9-10-300 BALLOONS

Ascension No.	#127	#128	#129	#132	Average of 4 Flights	#90	#98	#99	#100	Average of 4 Flights
Payload (lbs)	10	10	10	10		10	10	10	10	
Free Lift (grams)	300	300	300	300		700	700	710	700	
Gross Lift (grams)	5190	5190	5190	5190		5590	5590	5590	5590	
Date	8-14-57	8-14-57	8-14-57	8-16-57		7-31-57	8-5-57	8-5-57	8-6-57	
Start	11:30 AM	1:30 PM	5:26 PM	11:38 AM		11:15 AM	8:30 AM	10:00 AM	11:40 AM	
Finish	12:53 PM	2:56 PM	7:11 PM	1:03 PM		12:21 PM	9:46 AM	11:05 AM	12:46 AM	
Time in Flight (min)	83	86	105	85.7	90	66	76	65	66	68
T_2 / T_1 (°K)	223/298	214/302	207/302	214/290		211/296	217/290	217/298	213/294	
P_1/ P_2 (millibars)	1015/123	1003/113	1003/124	1000/148		1007/142	1018/154	1018/154	1008/147	
Burst Altitude (feet)	49,154	48,026	59,174	40,614	45,392	47,693	45,341	45,341	46,473	46,212
Average Rate of Rise (ft/min)	483	478	519	548	507	722	596	697	704	680
Burst Diameter (in.)	11.55	11.2	12.1	11.55	11.4	11.95	11.75	11.75	11.85	11.82
Burst Volume (cubic feet)	670	745	925	817	781	912	860	860	884	876
Ascent Rate From										
SFC to 5,000	667	926	820	639	750	1040	976	1020	942	995
5,000 10,000	587	781	848	562	693	1085	909	926	1110	1008
10,000 15,000	417	582	440	507	500	848	595	833	1040	829
15,000 20,000	403	431	467	549	401	676	510	658	676	632
20,000 25,000	417	438	390	402	427	610	472	544	610	534
25,000 30,000	447	473	430	500	450	641	544	675	582	598
30,000 35,000	481	490	427	522	480	610	595	508	634	602
35,000 40,000	547	481	455	544	507	604	485	597	530	569
40,000 45,000		437	407	564	409	678	580	683	685	648
45,000 50,000			450	575	505	690			640	665
50,000 55,000										
55,000 60,000										
60,000 65,000										
Minutes in Flight from										
SFC to 5,000	7.3	5.3	6.1	7.5	6.4	4.6	4.9	4.7	5.1	4.8
5,000 10,000	8.6	6.4	5.9	8.9	7.2	4.6	5.5	5.4	4.5	4.9
10,000 15,000	12.0	8.6	11.4	8.5	10.1	5.9	8.4	6.0	4.8	6.0
15,000 20,000	12.4	11.6	10.8	9.1	10.8	7.4	9.7	7.6	7.4	7.9
20,000 25,000	12.0	11.4	12.8	10.8	11.7	8.2	10.6	9.2	8.2	9.4
25,000 30,000	11.8	11.8	11.6	10.0	11.1	7.8	9.2	8.0	8.6	8.4
30,000 35,000	10.4	11.2	11.7	9.6	10.4	8.2	8.4	8.8	7.9	8.3
35,000 40,000	9.4	11.4	11.0	9.2	9.9	8.3	10.3	8.4	9.1	8.9
40,000 45,000		11.6	12.3	8.9	10.7	7.4	9.2	7.8	8.0	7.8
45,000 50,000			11.5	2.8	.8	3.9			2.3	1.8
50,000 55,000										
55,000 60,000										
60,000 65,000										

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

TASK II

Ascension No.	#39	#40	#51	#82		Average of 4 Flights
Payload (lbs.)	10	10	10	10		
Free Lift (grams)	1000	1000	1000	1000		
Gross Lift (grams)	5885	5885	5885	5885		
Date	7-11-57	7-11-57	7-19-57	7-26-57		
Start	11:50 AM	1:45 PM	4:15 AM	5:55 AM		
Finish	12:39 PM	2:35 PM	5:15 AM	7:03 AM		
Time in Flight (minutes)	48.6	50	50	68.4		54.2
T_2 / T_1 (°K)	217/306	218/306	222/302	211/305		
P_1 / P_2 (millibars)	1010/180	1011/152	1005/154	998/122		
Burst Altitude (feet)	42,638	46,178	45,689	50,374		46,220
ave. Rate of Rise (ft/min)	879	924	914	737		867
Burst Diameter (feet)	11.35	12.0	12.0	12.75		12.03
Burst Volume (cubic feet)	772	921	923	1105		930
Ascent Rate from						
SFC to 5,000	1040	1090	1170	1114		1110
5,000 10,000	1160	1388	1190	1190		1232
10,000 15,000	980	1315	1190	981		1110
15,000 20,000	927	1110	1312	793		1033
20,000 25,000	726	793	1250	663		843
25,000 30,000	806	848	795	588		759
30,000 35,000	730	705	660	685		697
35,000 40,000	835	758	665	610		717
40,000 45,000	826	758	685	667		732
45,000 50,000		785	689	617		684
Minutes in Flight from						
SFC to 5,000	4.6	4.4	4.1	4.3		4.3
5,000 10,000	4.3	3.6	4.2	4.2		4.1
10,000 15,000	5.1	3.8	4.2	5.1		4.3
15,000 20,000	5.4	4.5	3.8	6.3		4.8
20,000 25,000	6.9	6.3	4.0	8.3		5.9
25,000 30,000	6.8	5.9	6.3	8.5		6.6
30,000 35,000	6.8	7.1	7.0	7.3		7.2
35,000 40,000	6.6	6.4	7.5	8.2		7.0
40,000 45,000	3.8	6.6	7.3	7.5		6.8
45,000 50,000		1.5	1.0	8.7		1.8

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5

TABLE II

PRE-HEATED 5 MIN. @200°F

Ascension No.	#117	#118	#120	#121	#122	#123	#126	#130	Average of 8 Flights
Payload (lbs.)	3	3	3	3	3	3	3	3	
Free Lift (grams)	200	200	200	200	200	200	200	200	
Gross Lift (grams)	1685	1685	1685	1685	1685	1685	1685	1685	
Date	8-9-57	8-9-57	8-12-57	8-12-57	8-12-57	8-12-57	8-13-57	8-15-57	
Start	1:04 AM	3:05 PM	10:25 AM	12:16 PM	1:52 PM	11:45 AM	1:58 PM	10:20 AM	
Finish	2:31 PM	4:26 PM	11:59 AM	1:23 PM	3:26 PM	1:16 PM	3:11 PM	11:50 AM	
Time in Flight (minutes)	86.8	81	94.8	66.7	94	86	73	90	83.6
T_2 / T_1 (°K)	285/302	219/303	232/252	240/288	226/255	233/310	240/305	225/302	
P_1 / P_2 (millibars)	1007/235	1005/267	1018/207	1018/336	1008/238	1017/270	1010/214	1007/235	
Burst Altitude (ft.)	37,018	34,183	34,124	28,911	39,808	34,082	39,577	37,149	34,183
Ave. Rate of Rise (ft/min)	426	422	376	433	391	396	414	413	409
Burst Diameter (in.)	83.2	80.4	80.6	75.5	83.0	80.4	77.2	83.2	80.4
Burst Volume (cubic feet)	176	159	160	131	175	159	141	176	159
Rate of Rise (ft./min.)									
SFC to 5,000	527	FAULTY TRACES	373	386	466	368	494	386	429
5,000 10,000	373		250	393	365	357	476	390	386
10,000 15,000	376		337	428	342	370	398	373	375
15,000 20,000	400		362	428	367	397	373	391	389
20,000 25,000	400		357	462	413	395	390	427	407
25,000 30,000	438		454	528	403	424	416	442	443
30,000 35,000	472		424		427	483	412	438	439
35,000 40,000	500				320			457	
40,000 45,000									
Time in Flight (min)									
SFC to 5,000	9.1		12.7	12.4	10.3	13.6	9.7	12.4	11.2
5,000 10,000	13.4		14.3	12.7	13.7	14.0	10.5	12.8	12.9
10,000 15,000	13.3		14.8	11.7	14.6	13.5	12.5	13.4	13.3
15,000 20,000	12.5		13.8	11.7	13.6	12.6	13.4	12.6	12.9
20,000 25,000	12.5		14.0	10.8	12.1	12.8	12.8	11.7	12.3
25,000 30,000	11.4		11.0	9.4	12.4	11.8	12.0	11.3	11.3
30,000 35,000	10.6		10.2		11.7	8.4	1.4	11.4	9.3
35,000 40,000	4.0				6.0			4.7	
40,000 45,000									

Sanitized Copy Approved for Release 2011/05/03 : CIA-RDP78-03639A000500040001-5